73

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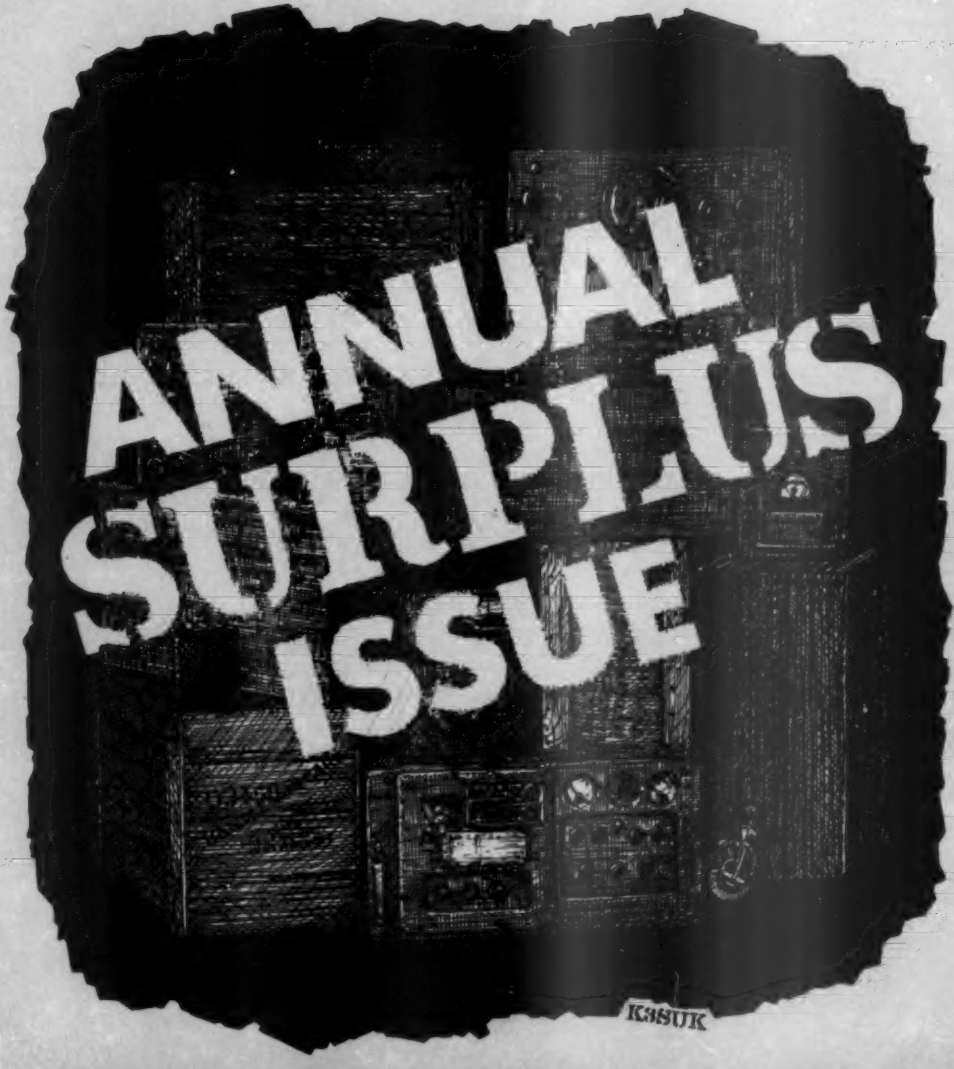

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73 Magazine

June 1967

Vol. XLVI, No. 6

Jim Fisk W1DTY
Editor

Jack Morgan K1RA
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The View from Here . . .

With all the technological advancements that have been made in amateur radio in the past few years, there's no reason why we must perpetuate antiquity by using AM on any of the high-frequency bands.

I'm sure this will evoke a few cries from isolated corners, but the fact is, if you listen in on the bands below 30 MHz at any time of the day or night, AM stations in the American phone band are few and far between.

Ten years ago it was the other way around—sideband stations were in the minority. Even five years ago the gentlemen's agreement on twenty meters was useful—now it is ridiculous. The two or three AM stations operating between 14200 and 14250 do a lot of complaining about the sidebanders' violation of this archaic agreement, but they're the only AM stations on the band. Everyone else has gone to more efficient and compatible sideband.

When king spark was outlawed in favor of CW and modulated oscillators were eliminated from the high-frequency bands, there were cries of anguish from a few who had fallen behind the times. The same thing is true today. There are always a few who fail to keep the pace.

The spectrum that we have available is limited and there's not a chance in the world that it will be enlarged. There's even a good possibility that we'll lose part of it. At the very best we'll have to contend with more and more intruders. Therefore, it's incumbent upon us to use the space we do have available to the best advantage. Maximum utilizations of the bands available, cannot, within any stretch of the imagination, include the use of Ancient Modulation. Most amateurs are aware of this and have switched to sideband.

Not only do AM transmitters require much more bandwidth, they are inefficient and in many cases, ineffective. This has been proven many times in the past, both theoretically and practically. If you can copy a station Q5 on CW, about 90% of the time you can make a successful contact on sideband. Don't try it on AM—90% of the time you won't make it.

Although spectrum utilization and interference are the two big arguments against AM, there is one other important consideration—state-of-the-art. In years past, amateurs donated much to the advance of the radio art. As our technology sky-rockets forward, there doesn't seem to be an awful lot that the backyard experimenter and amateur can contribute. However, we can use the best techniques that are available—this doesn't include AM; it went out with 872 rectifiers, general coverage communications receivers and swinging links.

A lot of the AM procrastinators will holler about the high cost of sideband. Bunk! You can buy a high-frequency sideband transceiver today from five or six prominent manufacturers for about the same thing you paid for a good communications receiver a decade ago. If you don't like transceive operation, remote VFO's are available from most of the same manufacturers for less than a hundred dollars.

Kilowatt power amplifiers are no problem either—if it will work on AM, a few modifications will turn it into a linear. In most cases all that is required are a few changes in bias. While all tubes were not designed for linear operation, most of them will perform pretty well when properly biased.

Furthermore, the conversion of an AM transmitter to double sideband is a relatively easy operation. Although double sideband uses twice the bandwidth of single side-band, it has at least the same efficiency and the troublemaking carrier is eliminated. The widespread use of single sideband has pretty much inhibited any serious experimentation with double sideband, but it appears to offer at least one advantage—synchronous detection. When a properly designed double sideband system with synchronous detection is used, QRM free QSO's are apparently the rule rather than the exception. Not that I'm advocating double sideband—I just think it deserves more investigation.

It doesn't really make a great deal of difference whether we use one sideband or two—either system is compatible with the other. Actually, there is little danger that double sideband will ever be very popular; single sideband equipment is too readily available.

None the less, AM is not compatible. It's not compatible with sideband, nor spectrum utilization, nor state-of-the-art. It's inefficient and ineffective. Isn't it about time we eliminated it from the high-frequency bands?

Jim, W1DTY

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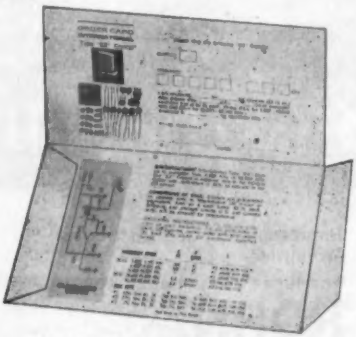

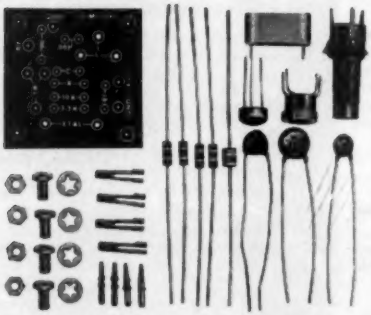

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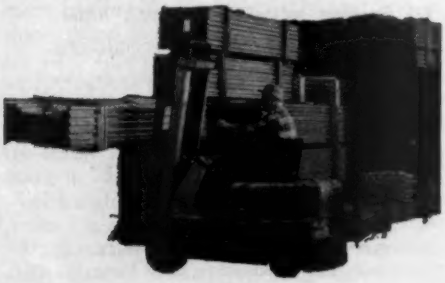

Letters

The Price of Progress

Dear 73:

. . . A few months ago I subscribed to 73 and had a rude awakening. I did not know the language well enough to read half the articles. Progress had run ahead of me and I was in bad shape. Since that time I have been trying to catch up and it's rough . . .

Just wanted you and your associates to know that you are greatly appreciated and I think you are doing a great job for the fraternity. Maybe some of the youngsters like to buy ready-to-operate, but there are still some of those left around that like to experiment and build our own. Again, thank you very much for the fine job you are doing. Keep up the good work.

Emery White, Sr. W4TQD
Glasgow, Kentucky

Dear 73:

. . . Your magazine is getting better all the time and you may yet make a technician out of a mathematician. Hi.

John Bauer
Kanata, Ontario, Canada

QRP

Dear 73:

The following might be of interest to younger hams and perhaps refresh the memories of some of the old timers. The following input powers were taken from QSL cards received from stations worked on 28 MHz in 1948. My call was then KZ5RS: OZ8J—12 watts; ZL1DW—70 watts; ZS1CG—25 watts; OQ5HL—60 watts; GM3BON—35 watts; and VK3PG—50 watts. My reports to these stations were 57 or better.

R. W. Stewart WA4EKF
Warner Robins, Georgia

The sunspots do make a difference.

Transistor Circuits

Dear 73:

Congratulations on your article by W1DTY—too bad you cut off the "T" in his call on the front cover of the March 73. His 73 transistor circuits are going to be a big help to this ham and a lot of others I am sure.

S. R. Gross W9OJI
Wheaton, Illinois

Dear 73:

. . . the transistor circuits article in the March issue was a real dandy and received a lot of favourable comment from the boys around here.

George Cousins VE1TG
Nova Scotia, Canada

Dear 73:

Only two tubes in the March issue—what did you do, fire the drawer of tube diagrams? If so, FB. Promote Fisk for his solid state jewel!

Ev Taylor W6DOR
Sacramento, California

(turn to page 136)

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The Whole of The Doughnut

How to use toroidal tank coils in high power amplifiers for increased efficiency with reduced size. Practical inductors are shown for 100, 500 and 1000 watts.

Toroid rf tank coils have brought a new era of construction technique to the amateur builder as well as commercial manufacturers. Spurred on by modern requirements for compact construction, the toroid has seen recent applications in DC to DC power converters, interstage audio transformers, and many other uses. Indeed, the largest single application of the toroidal coil is the television flyback transformer which has been taken for granted for years in the home TV set. Recent articles have described toroidal coil applications in VFO's,[1,2,3] low power transmitters,[4] VSWR meters[5] and multi-band tuners[6]. Now, for the first time, the outstanding advantages of toroids have been realized in higher power transmitter rf tank circuits.

The impact of toroids upon modern electronic equipment design has been of first order importance. Not since the advent of transistors or SSB itself, has so important an advance in construction technique been available to the electronics industry. Significant reductions in size, ease of packaging and improved efficiencies lead the list of reasons why toroids have emerged as the currently favorite tool of electronic designers.

Advantages of toroids

The most significant feature of the toroidal coil is that its magnetic flux is almost entirely contained within the coil itself. This means that generous spacing of the coil from adjacent components, panels and chassis need not be provided. Further, by virtue of using a powdered iron core within the coil, an adequate inductance can be achieved with fewer turns, smaller diameters and resultant smaller physical sizes. When fewer turns are used for the coil, larger gauge wire can be accommodated. Also, if the flux is restricted within the coil, greater Q and improved power transfer efficiency are achieved. These factors add to accomplish less heating loss within the tank coil assembly itself, resulting in more power output.

In rf tank circuits for example, we are able to achieve a volumetric size reduction of better than 8 to 1. Part of this is due to the fewer turns and smaller diameter winding which is possible. More importantly, however, less spacing is required around the coil to accomodate its magnetic flux, because this flux for the most part is contained within the toroid. Therefore, a favorably high Q is achieved without spacing the coil at least one diameter away from the chassis as would normally be required with conventional construction. While toroids promise many desirable features, several new design considerations must be recognized. The higher Q presented by a toroidal coil makes its tuning relatively sharp. This is particularly true when tuning an unloaded or lightly loaded tank circuit. There-

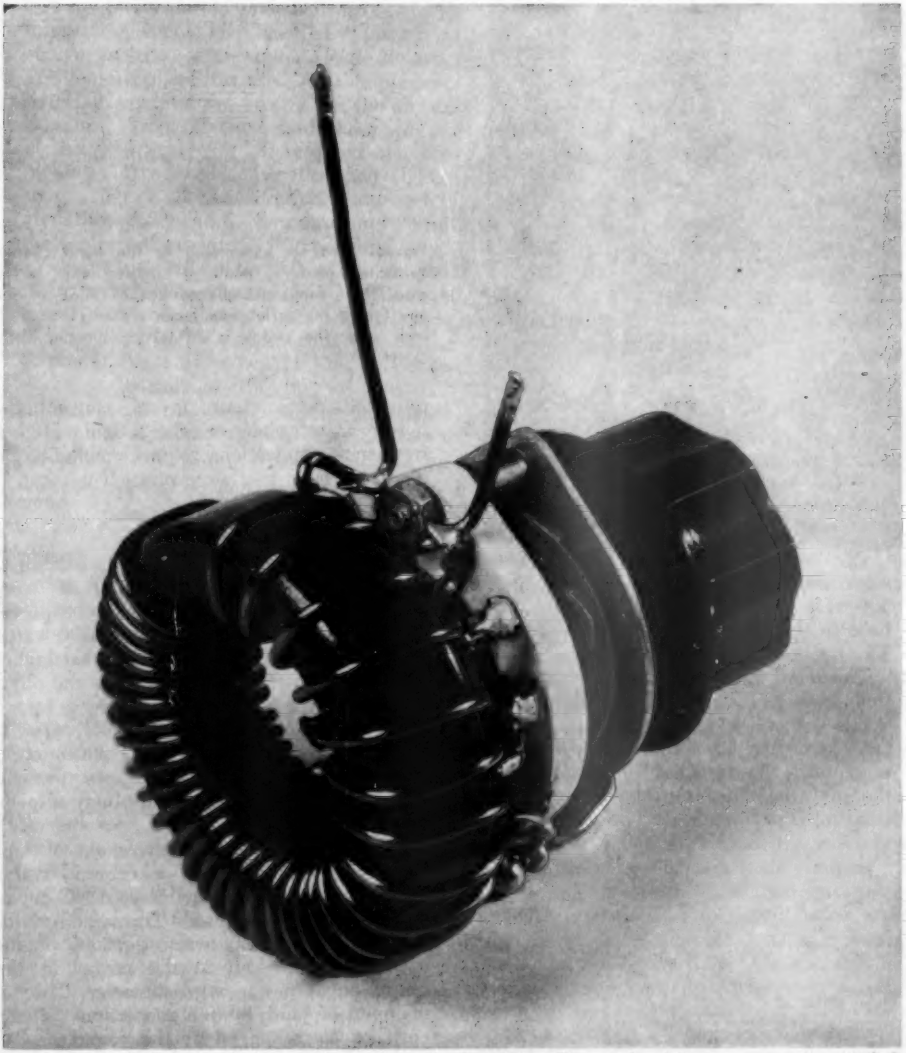

Fig. 1. Toroidal rf tank coil for use in a 100 watt transmitter. The powdered iron core provides High-Q and therefore, good energy transfer. Compact construction results in a tank coil only a fraction of the size normally encountered in conventional designs. The core is given several coats of epoxy cement prior to winding so as to prevent flash-over from the winding to the core.

fore, when a toroid is used in a transmitter final tank circuit, it may be necessary to "re-dip" the final more often than a conventional circuit when changing from one operating frequency to another. Also, when the quasi-conductive powdered iron core is placed within a high power rf tank coil, some tendency toward flash-over to the core is experienced. However, with proper precautions and adequate spacing as described later, this tendency can be eliminated.

The toroidal core

Cores for the toroidal tank coils described in this article were obtained from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California. Their model T-200-2 was selected for its large size (2 inch out-

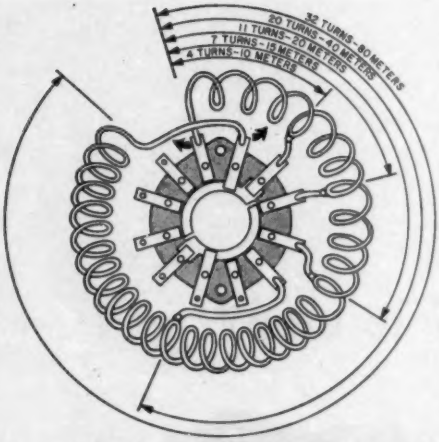

Fig. 2. Winding data is given here for the 100 watt coil. Enameled copper wire (#14 AWG) is used. Windings have a greater spacing at higher frequencies in a manner typical of multi-band tank coils.

side diameter) and 2 kW PEP rating from 500 kHz thru 30 MHz. This same core is used in the Ami-Tron *Signal Antenna Balun Kit*.

Powdered iron cores are manufactured from iron ore by a process called "sintering". While several special proprietary processes enter into their fabrication by different manufacturers, the essential process requires a thorough dehydration by baking and pulverizing of the iron ore. The resultant iron granules are then compacted or sintered in a properly shaped mold under extreme pressure and high temperature. Organic binders are generally not used. Rather, a mechanical inter-granular adhesion is achieved which produces a solid mass with each iron granule being electrically quasi-insulated from the rest. This is needed, as we know, to prevent hysterisis losses and is analagous to the

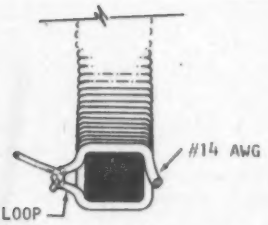

Fig. 3. Taps for connecting to the band change switch are made to small "U" shaped loops in the wire. These loops are placed on the edge of the coil facing the switch and leads are only about ½ inch long. The switch is a Mallory ceramic wafer switch.

insulated laminations in a conventional power transformer or choke coil. Higher frequency applications require smaller granule sizes.

The 100 Watt toroid

In our experimentation with toroids in rf tank circuits, three different sizes were selected to satisfy three different power ranges; 100 watts, 500 watts and 1000 watts. The builder might well use somewhat higher or lower powers in connection with the physical sizes of the coils illustrated here.

Corona flash-over to the iron core mass is eliminated by first coating the T-200-2 toroid core with several coats of epoxy cement. Teflon, vinyl or fiberglass tape may also be used for this purpose. Fig. 2 gives the winding data and shows the placement of taps which are connected to a ceramic wafer band change switch. Number 14 AWG enameled copper wire is used. The windings for the 10, 15 and 20 meter portions of the coil are spaced out at the center of the toroid equal to the wire diameter. The remaining 40 and 80 meter portions of the coil are close spaced at the toroid center.

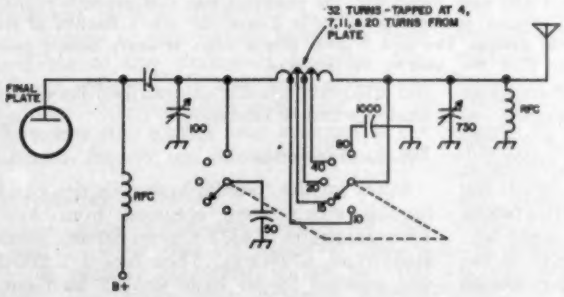

Fig. 4. Schematic of a typical pi network. Additional fixed capacitance is provided at both the input and output in the 80 meter position. This permits smaller tuning capacitors to be used.

Taps to the toroid tank coil are made by forming a small loop in the winding as shown in the cross-section, **Fig. 3.** Stout needle-nose pliers are used for this purpose. After all windings are completed, the enamel is scraped from the loop and short sections of the #14 buss wire are soldered on, completing the connections to the band change switch. These short sections provide a rigid mounting of the coil to the switch and permit the completed assembly to be panel mounted.

The reader will note that a double pole wafer switch was selected for the 100 watt toroid tank coil. This permits the switching in of a fixed 50 pF padder capacitor on the 80 meter band as shown in **Fig. 4.** Consequently, the smaller 100 pF variable tank capacitor can be used, resulting in further space and cost savings. In the 80 meter position, a switch tap is also available for padding the output or antenna loading capacitor.

Winding toroids

When winding toroids commercially, specialized machines are used. Large numbers of turns are made by passing a bobbin of wire thru the toroid on a circular guide ring. Winding rf tank coils with heavy gauge wire presents a whole new family of problems. The toroids in this article were all wound by hand with a pre-determined length of wire.

The builder's first inclination is to hold the core in a bench vise and pull the turns taut with pliers as shown in **Fig. 5.** Don't do it! A broken core is bound to result. The core should be held by hand and each turn is pressed into place. While this is a challenge to the strength and endurance of one's fingers, it is necessary for successful toroid construction. Powdered iron cores are fragile and if one happens to be dropped or otherwise broken, it can be cemented together again as shown in **Fig. 6.** Remember, that insulation between the iron granules of the core is fundamental to its design. Avoid use of organic cements which deteriorate with heat or age.

The following are a few pointers which will ease the task of designing and winding toroids employing heavy gauge wire:

1. If the proper number of turns is not known, wind the coil first with small size bare wire. It will be easier to wind, easier to space out the turns and more convenient to solder on taps to verify where they should be placed. After making the necessary electrical measurements, the small wire can be clipped loose, discarded and replaced with wire of the proper size.

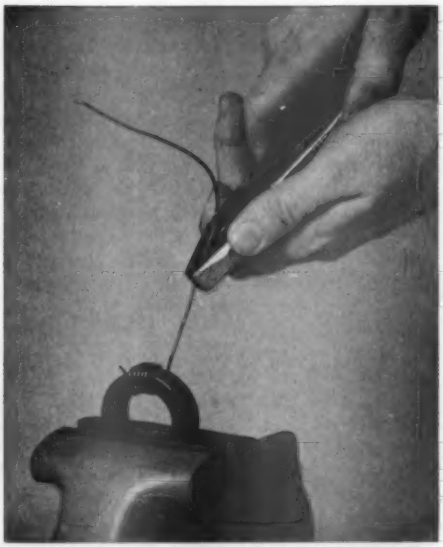

Fig. 5. How not to wind your toroidal coils! The fragile core is sure to break if heavy wire is pulled taut with pliers. When winding toroids, the core should be hand held, and the wire pressed into place with your thumb.

Fig. 6. Broken powdered iron cores may be repaired with epoxy or household cement. Core material is a quasi-insulator and electrical contact between the broken pieces is neither required nor desired.

Fig. 7. Medium power (500 watt) toroidal tank coil employs one powdered iron core. The polystyrene end-spacers prevent flashover from the winding to the core. Coil taps for the various amateur bands are made to the outside of the windings that bridge across the two end spacers.

2. The length of heavy gauge wire required should first be calculated or simulated with string. This will avoid the inconvenience of threading an excessive length of wire through the toroid and will eliminate wastage when cutting off the surplus after the proper number of turns are reached.

3. Note the direction to which the windings advance; left to right. Determine the proper winding direction so that taps for the various bands proceed from left to right when viewing the band switch from the front panel.

4. Prior to starting the winding, straighten the wire and remove kinks. This can be done by holding one end in a bench vise and jerking the far end with a pair of pliers. Alternately, the far end can be twisted an equal number of turns to the right and then to the left with a hand drill. Avoid excessive working of the copper which causes it to harden and become more difficult to handle.

5. Start winding from the center of the measured length of wire and work toward each end. This eliminates passing the total length of wire through the toroid core on each turn. It also minimizes work-hardening of the wire and kinking due to excessive handling.

6. Press wire firmly in place on each quarter-turn so that tight windings and neat right angles are obtained on each turn.

7. Prior to passing the free end of the

wire thru the core, unwind the last quarter turn slightly. This permits the wire to thread through parallel to the axis of the core and avoids kinks.

8. When spaced turns are called for, first wind them close spaced. After the proper number of turns are in place, space them out to the desired locations. This results in neater windings and tends to tighten them upon the core.

500 watt toroid coil

Fig. 7 shows the 500 watt toroid. An Ami-Tron T-200-2 core is also used with this coil. The band change switch pictured with the coil is the husky tap switch taken from a surplus BC-375 antenna tuning unit. These are still available for little cost from surplus dealers who advertise in this magazine. If a new switch is to be purchased for this purpose, the Ohmite power tap switch model 111 or 212 will work very well.

The reader will observe that insulating end spacers have been employed to hold the wire away from the powdered iron core material. About one-eighth inch of space is thus provided and has served well to prevent flash-over from the coil to the core. This spacing is about equal to that usually used between the rotor and stator of a tank capacitor selected for this power level.

Enameled copper wire of #12 AWG size is used for the 500 watt toroid coil. It is wound using the same general instructions as used with the 100 watt unit. Because a larger coil diameter results from use of the end spacers, fewer turns can be employed. This is a welcome advantage due to the smaller inner diameter of the end spacers and less space which is available for the windings. Fig. 8 gives the winding data and tap information for the amateur bands from 80 to 10 meters inclusive.

1000 watt coil

Fig. 9 illustrates the high power coil which is suitable for 2 kW PEP on single sideband. The 10 meter portion of the coil has been externally wound. This was done to provide further isolation of the high impedance or highest voltage end of the coil from the powdered iron core. Copper tubing of 3/16 inch diameter is used for the 10 meter coil and #10 AWG tinned copper buss wire is used for the remainder of the coil within the toroid core.

In the 1000 watt coil, two Ami-Tron T-200-2 toroid cores are used to minimize the possibility of core saturation and "flat-topping". Prior to winding, the two cores as well as the end spacers are cemented together with epoxy cement. This makes winding of the coil much easier. Alternately, the two cores and two end spacers could be temporarily clamped together or lashed with string until the initial windings are in place.

The heavy duty band change switch is again used as previously described. Even with the greater mass presented by the two cores and heavier wire, no problem was encountered in making the complete assembly rigidly panel mounted by short pieces of #10 AWG copper buss connecting the taps to the band change switch. Fig. 10 provides the winding data for the high powdered coil. This spacing is ensured by placing small ¼ inch by 2 inch pieces of 1/16 inch aluminum or plastic between the turns at the center of the coil. After proper and uniform spacing is achieved the individual turns are secured to the end spacers with epoxy cement. The temporary spacers can then be removed.

End spacers

Polystyrene sheet ¼ inch thick is used to

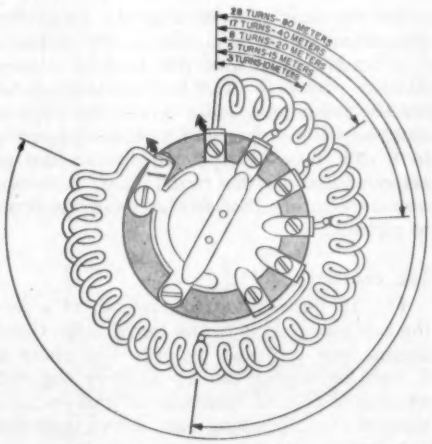

Fig. 8. The medium power toroid tank coil uses a surplus switch from a BC-375 Antenna Tuner. Windings are made with #12 AWG enameled wire. Fewer turns are required when the end spacers are used due to their producing a larger effective coil diameter. The 10 and 15 meter windings are spread out slightly more than the rest of the coil.

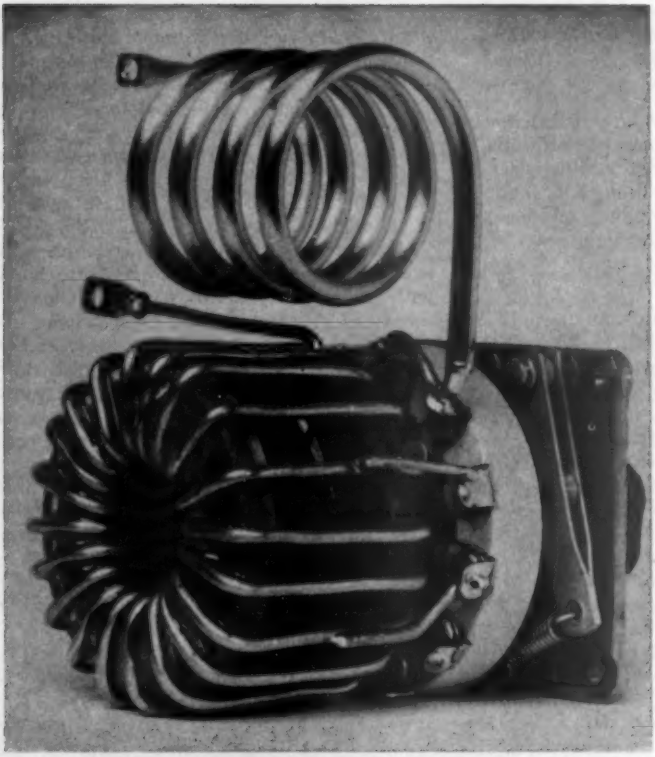

Fig. 9. High power tank coil for 1 kW operation. Two cores are stacked to lessen the possibility of core saturation. Larger wire (#10 AWG) is used in this model. The same heavy duty band change switch is used for this and the medium power version.

make the end spacers. **Fig. 11** gives the dimensions of these pieces. Lucite or bakelite should not be used due to their inferior dielectric strength. The end spacers can be readily make on a lathe or can be cut out and recessed by means of a chassis fly-cutter in a drill press. If the end spacers are to be cemented to the toroid core, it is not necessary to cut the circular recess in them as pictured.

Tap connections

Fig. 12 shows alternate methods of securing tap connections to the toroid coils. Good success was achieved by providing about a ⅛ inch overlap of the tap lead on the coil winding. Solder is cautiously flowed on both sides of the tap taking care not to melt the polystyrene end spacer material. When assembling the coil to the band change switch, it is desirable to first form and solder the two major coil ends to their proper terminals on the switch. This serves to position the coil and makes it more convenient to form the taps and solder them in place.

Coil measurements

A Boonton Q Meter is invaluable in the empherical design of coils. However, such an instrument is not generally available to the amateur constructor. In lieu thereof, a grid-dip meter and calibrated capacitor will serve for frequency determination. A recent article in *73 Magazine*[7] described this method. The three toroid tank coils were measured on a Boonton Q-meter and the following unloaded Q values were recorded:

Band	100 watt	500 watt	1000 watt
80	310	360	332
40	177	200	190
20	160	205	188
15	132	186	190
10	128	146	250

The lower Q values measured at the higher frequency bands are due to the coil being "bunched-up". That is, the small number of turns occupy only a fraction of the total core length. To achieve maximum Q for any given number of turns, those turns should be spaced out evenly over the whole core

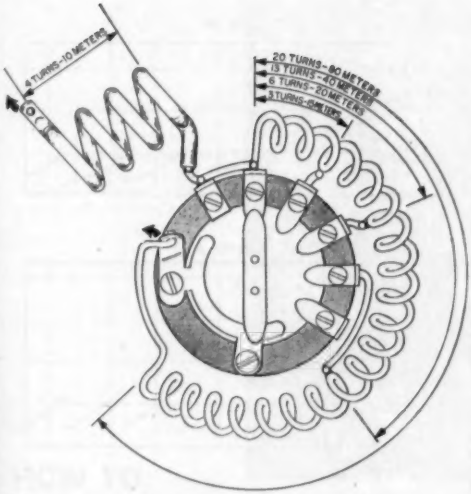

Fig. 10. The high power coil utilizes two powdered iron cores whose larger winding cross section requires that still fewer turns be used than for the medium power coil. While it is optional with the builder, in this case, the 10 meter section of the tank was externally air-wound. This is desirable because it reduces the electro-potential stress between the "hot" end of the coil and the core. Four turns of 3/16ths inch diameter copper tubing are wound on a 1¼ inch diameter form and spaced out to 1¾ inches long.

length (or circumference). This situation is always encountered with a multi-tapped coil. It is interesting to note that the high power 10 meter coil has a relatively high Q. This is obviously due to its heavy construction, optimum length/diameter ratio and the fact that it is self-supporting, external to the toroid.

Fig. 13 provides a handy guide in determining the value of tank capacitance to be used in resonating these coils. Of course, the first step to be taken when designing a resonant tank circuit for your transmitter is to select the proper L/C ratio to match the tubes output impedance. The toroid coils described in this article are suitable for most tubes in common use today. However, if several amplifier final tubes are paralleled as is frequently done, the reader should be guided by the references on this subject in one of the amateur radio handbooks to obtain a proper L/C ratio.

The future of toroids

Having already gained wide spread use in

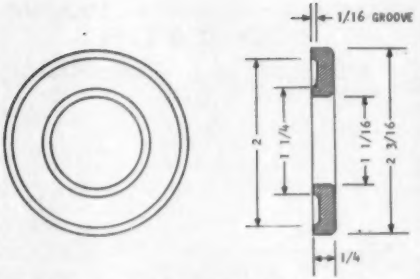

Fig. 11. Drawing showing dimensions of end-spacers used on both the medium and high power toroidal tank coils. Polystyrene, ¼ inch thick is used to make the end-spacers by means of a chassis fly-cutter mounted in a drill press. Wire tension and friction hold the end-spacers in place.

many lower power applications, toroids can now be used to great advantage in high power transmitters. Perhaps before long, commercial transmitters will be using toroids. In the meantime, the amateur may avail himself of their superior compactness and efficiency and thereby continue the pioneering heritage which has earned the amateur radio operator and constructor his place of respect today.

Acknowledgement

Mr. Joe Williams, W6SFM, of Ami-Tron Associates was most helpful in furnishing toroid core material, technical advice and encouragement in developing the coils described here. To Mr. Paul Sellers, W4EKO, goes thanks for early design criteria and the pioneering approach to high power toroid rf coils. The assistance of Mr. Frank Emens. W4HFU, was invaluable in making coil measurements, and Mr. Jim Bauman and

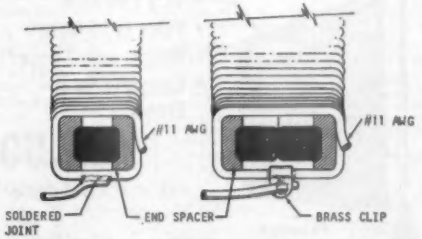

Fig. 12. Details of alternate methods for making the tap connections to the toroidal tank coils. Care must be taken to prevent solder from bridging over to the core, thus promoting a flash-over. Excessive heat must be avoided when soldering near the end-spacers so as to prevent their being melted.

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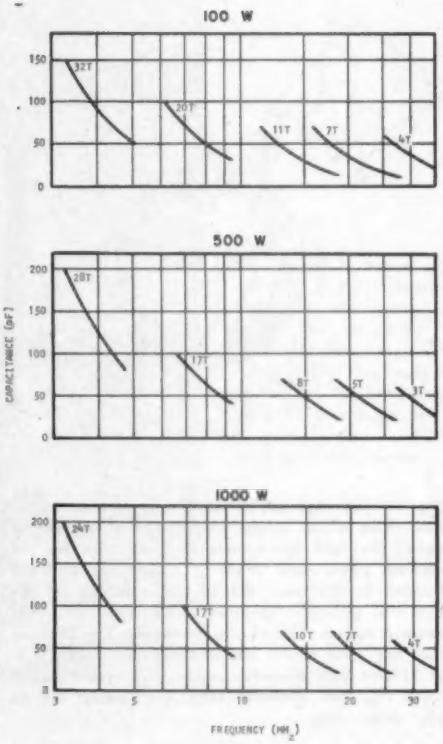

Fig. 13. Charts showing the capacitance required to resonate the three toroid tank coils on the five amateur bands. The L/C ratios obtained on each band match the tube impedances most frequently used today. If a very low tube output impedance is encountered, such as found in paralleling of many TV tubes, a much lower L/C ratio would be called for.

Mr. Jack Hood of RCA, Huntsville, Alabama deserve credit respectively for the model shop work and art work used in this article.

. . . W4BRS

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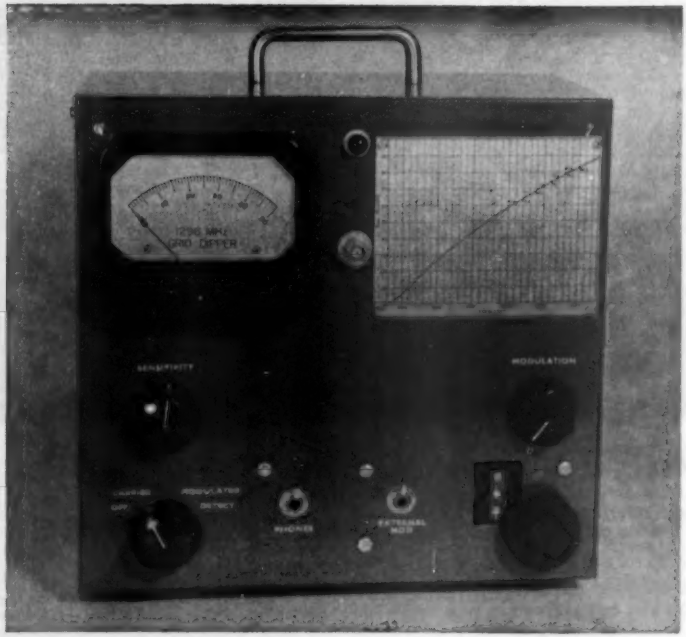

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A 1296 Grid Dipper

Conversion of the APX-6 transponder to a grid-dip oscillator that covers from 1050 to 1320 MHz.

One of the big problems with operating on 1296 MHz is locating the operating frequency of your equipment. Not only is the newcomer faced with this problem—any longtime resident on 1296 will attest to the many checks he has made to ascertain operating frequency and band edges. Some UHF amateurs have been able to obtain signal generators that cover the 1215 to 1300 MHz band, but many must resort to the time-proven lecher-wire system for any meaningful frequency measurements on this band.

Each of the systems commonly in use suffer from one disadvantage or another. Moreover, there is no commercial grid dip meter on the market, to my knowledge, which will cover this range. Most of them stop at 1000 MHz or so. This conversion of the APX-6 is not difficult and results in a very versatile grid-dip meter. Like its lower frequency counterparts, it may be used for dipping resonant circuits, detecting rf energy or as a signal source. The built-in Veeder-Root counter provides excellent frequency readout and the internal gear system ensures repeatability.

The only part of the APX-6 you need for

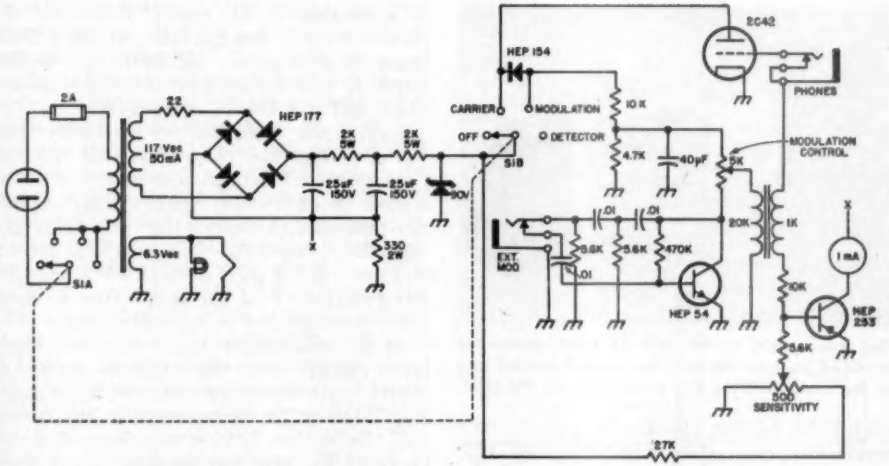


Fig. 1. Schematic diagram of the APX-6 grid-dip oscillator. Note that a 2C42 is used in the oscillator instead of the original 2C46. The built-in bypass capacitors and cavity inductance are not shown in this drawing.

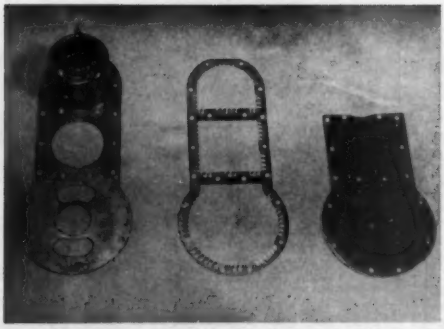
this conversion is the cavity assembly. You can buy the door assembly of the APX-6 from many surplus dealers, but this contains the *if* strip which you don't need. In any case, the cavity assembly, with or without the *if* strip can usually be obtained for less than ten dollars. I picked mine up at an auction for five bucks—the original owner had started to convert it but evidently had given up. No matter, the transmitter and T-R cavity don't serve any useful purpose in this conversion. In fact, if you can obtain an APX-6 that has already been converted for use on 1215 MHz, by all means do so. Many times units that have already been converted go for much less. The only requirement for this conversion is that the receiver local oscillator cavity has not been disturbed. This is the case in most of the popular conversions.

The first step in this conversion is to pull out the tubes and separate the cavity assembly from the door. Now remove the screws holding the cathode cavity plate to the cavity body and the six screws holding the cavity body to the gear and counter housing. To remove the cavity body, pull it straight up from the casting. With the unit broken down to its three main parts, we can start the actual conversion process.

First of all, pull the plate off the back of the gear housing. Inside you will find tnree sets of bevel gears and the rest of the paraphenalia that translate cavity plunger movement into numbers on the counters. Turn one of the counters up to 999 or down to 000. Note the tab on the horizontal gear which engages with the tab on the small bevel gear to prevent further movement of the tuning plunger. As you look at the casting from the rear, the receiver cavity is on the left, the diplexer (transmit-receive) cavity is in the center and the transmitting cavity is on the right.

Remove the five screws which hold the bottom plate on the housing and carefully remove it from the casting. It has to be pulled straight out. Three long pins with small locating tabs at the top are mounted on this plate. These tabs fit into keyways located in the tuning plungers. The receiver and diplexer plungers are removed by pulling them out from the gear end; the transmitter plunger is lifted from the top after unscrewing it from its drive gear. Now remove and discard the transmitter and diplexer Veeder-Root counters and gear trains. To remove the ¼ inch drive shafts (on which the knobs were mounted), drive out the small retaining pins with a pin punch.

Unscrew the receiver tuning plunger from the gear assembly and cut ⅝ inch off the end. This can be done on a lathe by any machinist or, with care and a very fine hacksaw, at home. To prevent undesired resonances the cut must be exactly perpendicular to the plunger axis—this is best accom-



The three pieces of the cathode cavity plate—the modified plate to the left, the serrated contact ring in the center and the new plate cover on the right.

plished on a lathe. Handle the plunger very carefully so the surface is not scratched. If it is damaged, the diplexer plunger may be used as a substitute.

While the plungers and gears are out of the housing, remove the shoulders around the transmitter and diplexer drive shafts on the front of the casting. If these shoulders are not cut off with a hack saw or filed down, the completed unit won't sit flush against the new front panel.

After the piece is cut off the tuning plunger, screw it on the gear drive assembly and push it through the contact fingers on top of the gear housing. Set the Veeder-Root counter to 000 and put the bottom cover in place. Now you have to do a little juggling. Adjust the plunger so it just protrudes through the contact fingers. Now mesh the drive gears so that the *stop* tabs engage. Usually you'll have to move the gears a few teeth each way to get the shaft to stop with the counter on 000. When the gears are all lined up, install the screws in the bottom cover.

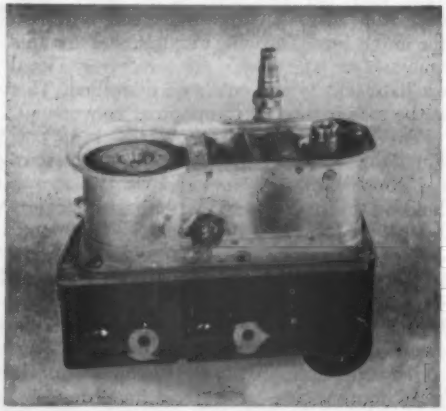
The first step in the conversion of the cavity body is to remove the large coaxial connector. Remove the screw from the split collar which holds the connector on the front of the cavity. When the screw is removed you should be able to rotate the connector in the collar. The center contact is soldered to a pickup loop which is located in the wall between the diplexer and transmitter cavities. When this joint is unsoldered the connector may be easily removed. Remove the collar by unsoldering it from the front of the cavity.

Cut out a piece of copper 1-23/32 inches wide by 2-1/4 inches long. This will be used as a partition in the center of the old diplexer cavity. If you cut this partition a little larger than required and form lips at the edges, it may be force-fit into the diplexer cavity and no soldering is required.

Look down inside the receiver cavity. You will note that the plate voltage is applied through a feedtthrough capacitor (C403) to a piece of wire which winds spirally around the plate line. Unsolder this wire from the capacitor, remove the three retaining screws and pull out the plate line. This line must be shortened by ⅜ of an inch. This is most easily accomplished with a tubing cutter.

In the unmodified APX-6 the local oscillator energy from the receiver cavity is coupled into the crystal mixer with the small loop adjacent to the aperture in the cavity wall. Somewhat heavier coupling must be provided for grid dip service. Cut a strip of copper ¼ inch wide and about 2¾ inches long. Form a short tab on one end of this strip and solder it to the bottom of the receiver cavity about ¼ inch out from the wall. Put a "Z" bend in it as shown in **Fig. 2.** and solder it to the contact on the crystal mixer. After the new coupling loop is in place, put the modified plate line back in place and reconnect the B plus line to the feedthrough capacitor.

Unscrew the connector from the crystal mixer and pull out the diode. Remove the crystal retaining fingers from the BNC connector with a pair of pliers and push an awl through the ceramic capacitor which is built into the connector. Remove the pieces of ceramic and pull out the center contact.



Front view of the cavity assembly and gear housing before installation of the cathode cavity plate.

Save this female pin. If the ceramic capacitor is not removed, all of the 1200 MHz oscillator energy will be bypassed to ground.

If you look closely at the back end of the mixer assembly you will see a round cover plate which is soldered in place. You will also see that a small hole has been drilled through this plate. Form a small hook in the end of a piece of #16 buss wire and hook it through this hole. Heat the cover plate with a small torch and when the solder is softened, pull the plate free with the buss wire. Solder a two inch length of #18 wire to the center contact of the mixer assembly and run it up through the connector body—cut it so it extends 13/16" above the threaded shoulder. Solder the female connector pin to the end of this wire and replace the BNC connector. Replace the round cover plate on the rear of the old mixer assembly and solder it in place. Modifications to the cavity body are now complete.

Unsolder the diplexer cavity from the cathode cavity plate and discard it. Discard the transmitter cathode cavity and saw off the grid contact fingers which extend above the plate at the transmitter end. Using the cathode cavity plate as a guide, cut out a piece of thin aluminum as shown in the photographs to cover up the holes. This cover serves no functional purpose, but it does make a neater looking unit. All that is left are the modifications to the receiver cathode cavity.

If you look inside the receiver cathode cavity, you will see that the grid contact is suspended from the top of the cathode cavity with three wires. These wires are soldered to both the cathode cavity and the grid ring. Carefully unsolder the support wires from the top of the cavity and pull out the grid ring; remove the three wires. Enlarge the three holes in the top of the cavity with a reamer, install three 500 pF feedthrough capacitors (Erie X5UO 501M or equivalent), and solder them in place. These feedthroughs consist of a coaxial shell and are actually only half a capacitor—when you run a wire through the center, the capacitor is formed. If you can't locate this type of capacitor, you can make your own by unsoldering and removing the center conductor from a conventional feedthrough capacitor.

Solder three 1⅛" lengths of #16 buss wire to the grid ring and put it back in the cathode cavity with the new support wires going through the feedthrough capacitors.

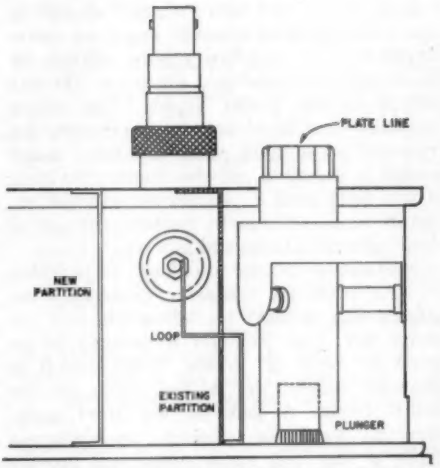


Fig. 2. Cutaway view of the APX-6 receiver cavity showing the location of the new pickup loop.

Place the 2C46 in the cathode cavity and use it as a guage for placing the grid ring in the proper position. When you have everything all lined up, solder the three supporting wires to the feedthrough capacitors. It's a good idea to check for shorts between the grid ring and the cathode cavity before soldering everything down—they should be electrically isolated for dc.

The APX-6 cavity modifications are now complete. It will tune smoothly from about 1050 MHz to well over 1300 MHz and grid current may be monitored in the modified cavity. All that is left is the power supply and modulator.

For maximum stability the power supply is regulated with a zener diode. The ninety volt supply is more than adequate for this purpose—when the grid is shorted to ground the grid current is nearly 1 mA. With the 10,000 ohm grid resistor, grid current is on the order of 150 A. A 200 microampere meter

Closeup view of the modified APX-6 local oscillator cavity showing the installation of the grid-ring feedthrough capacitors.

is ideal for this grid dipper, but since I had a large 1.5 mA meter which I wanted to use, I incorporated a simple transistor meter amplifier. The negative supply voltage for the amplifier is developed across the 330 ohm resistor in the power supply. The meter amplifier transistor and bias resistors are mounted on a small piece of Vector board which is mounted on the meter terminals. If you don't want to use the meter amplifier, simply connect the meter between the arm of the sensitivity control and ground.

Modulation of the oscillator is provided by the 1000 Hz transistor phase-shift oscillator—modulation is adjustable up to about 90%. The oscillator is constructed on a small piece of Vector board which is mounted behind the APX-6 cavity on the main chassis. A jack on the front panel may be used for external modulation—a three to four volt audio signal will provide 90% modulation.

I built the chassis for my APX-6 grid-dipper from sheet aluminum, but a standard 12" x 11" x 8" utility cabinet can be used if you don't like to bend aluminum. My chassis is 11" wide, 10⅛" high and 5⅛" deep and consists of two U-shaped pieces. Bracing is provided by two brackets across the top and bottom as shown in the photographs. These brackets are made up from do-it-yourself aluminum angle and actually serve two purposes. In addition to strengthening the chassis, three tapped holes in each bracket accept the cover retaining screws. The front panel is laid out as shown in Fig. 3. Even if you don't use this type of chassis construction, it is recommended that you use this panel layout.

The parts placement was chosen to provide a balanced layout. This means that all the available space is used. In fact, the two phone jacks occupy space previously taken up by the discarded counters in the gear housing. If they are moved to any great extent, they will interfere with the gear housing. The layout for the square counter cutout and five cavity mounting holes are not shown in Fig. 3—these are best obtained by using the old APX-6 door as a template.

Construction is quite straightforward and no problems should be encountered. Note, however, that the phone jack in the grid lead must be isolated from ground—this is easily done with fiber washers. Since the jacks are hidden by the gear housing when the cavity is attached to the front panel, wiring to them is run through the small screw holes drilled in the bottom of the housing. These holes were originally used to hold the counters in place.

The output of the oscillator is connected to the front panel connector with a short

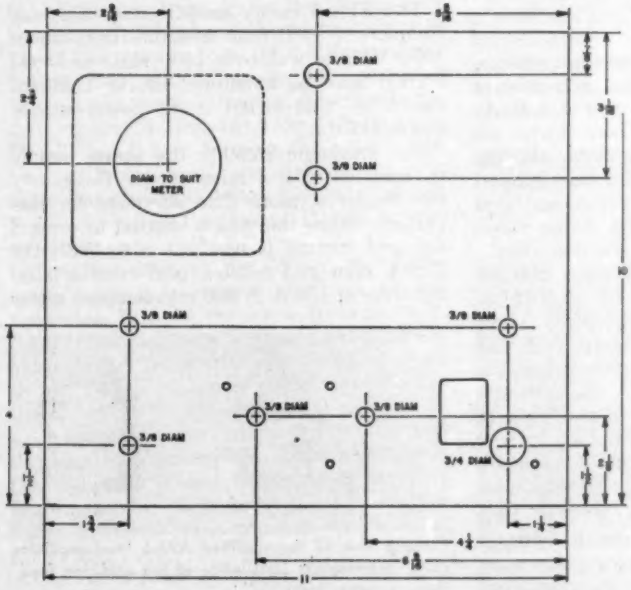
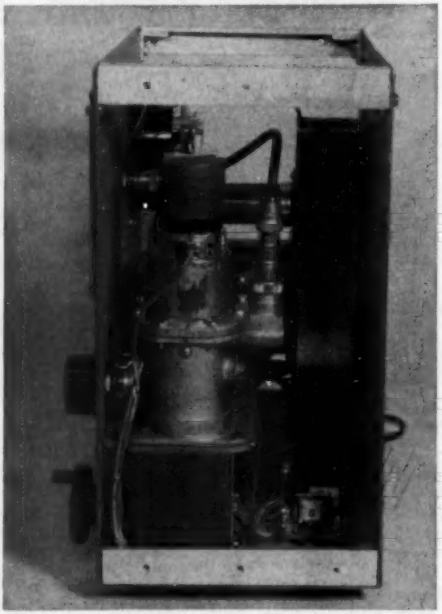


Fig. 3. Front panel layout for the APX-6 grid dipper. The locations of the square counter cutout and cavity mounting holes are not shown—they are best determined by using the old APX-6 door as a template.

length of coaxial cable. One of the newer Teflon insulated cables would be ideal for this purpose, but RG-58/U is perfectly adequate—that's what I used. Mismatch losses at the BNC connectors may be minimized by using the connector assembly diagrams in 73*.

Although a 2C46 was used in this cavity in the original APX-6, I found that it would not *always* oscillate in the modified cavity when power was applied. Substitution of the 2C42 from the old transmitter cavity solved this problem. An added bonus was the extra power output available with the 2C42.

Since there is a considerable difference in grid current between the oscillator and detector modes, be sure to turn down the sensitivity control before switching from one mode to another. If you don't, the needle will slam against the pin. It's also a good idea to turn the modulation control down when modulation isn't required. Since the meter indicates the relative magnitude of the modulating signal, less meter sensitivity is required when the oscillator is modulated. If the modulation is turned up when you switch from carrier to detector through the modulated position, a bent meter pin is inevitable.



Inside the APX-6 grid dipper. The phase-shift modulator is in the right foreground, the power supply chassis is mounted on the rear panel. The cover is held with screws through the tapped holes in each of the four corner braces.

*"Coaxial Connector Handbook", WA6BSO, *73*, August 1966.

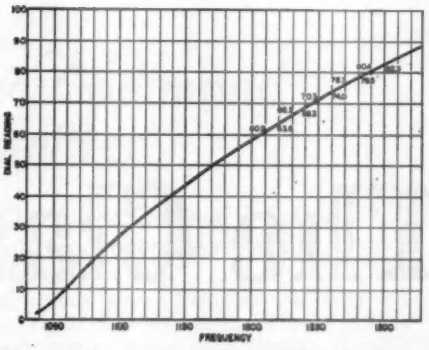


Fig. 4. Calibration curve of the APX-6 grid dipper. Counter readings for each 10 MHz point in the 1215 MHz band are included for accurate interpolation.

After you have completed the unit, all that is left is calibration. There are several approaches at this point, depending upon the type of equipment you have or can borrow. Lecher wires are the most straight forward but not necessarily the easiest. I used a General Radio 1140A wavemeter and an old surplus echo box and then made a double check with an LAE signal generator which covers this range. The calibration curve (Fig. 4) was then mounted on the front of the grid dipper for easy reference.

The completed unit tunes very smoothly through its range with no jumps in frequency. A few false dips in grid current appear around 1100 MHz, but in the main range of interest, 1200 to 1300 MHz, there are no false dips. In the detector mode, rf signals down to several millivolts provide an upswing on the meter. When used as an oscillating detector with headphones, significantly lower magnitude energy may be readily detected.

For the amateur who is interested in operating on the 1296 band, this grid dipper is a very useful piece of equipment. It may be used for tuning up converters, dipping out filters, detecting parasitics, determining transmitter frequencies and in tuning up frequency multipliers. In a pinch it may even be used as a low power transmitter by plugging in an external modulator.

. . . W1DTY

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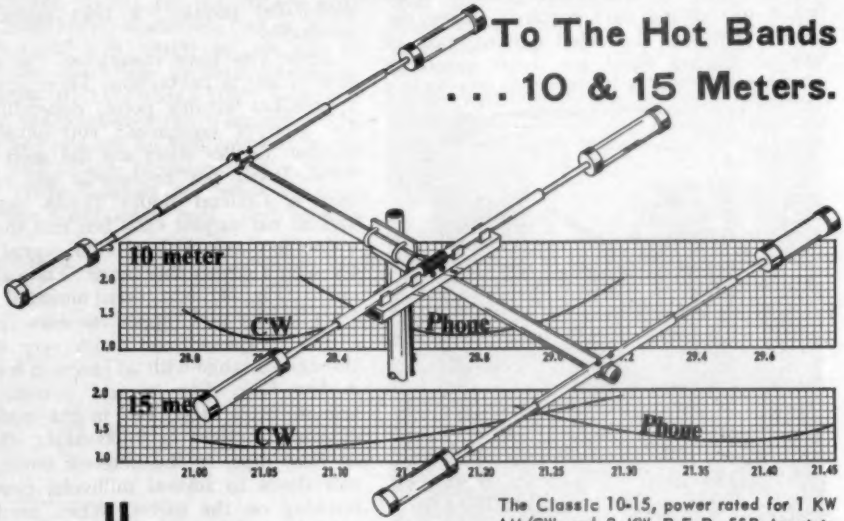

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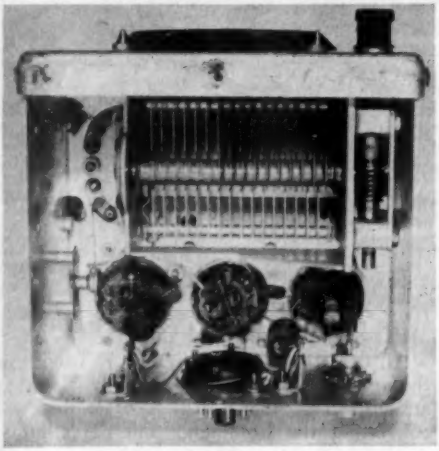
Richard Palace K3LCU
4402 Clearfield Road
Wheaton, Maryland

Using FET's in the Command Set Transmitter

How to build a very stable VFO using a Command Set and three transistors—one FET and two conventional types.

Do you need a good stable VFO that's quite easy and inexpensive to build? Well I did, and after discarding many possibilities I came back to the old reliable Command Set. Tubes were definitely out—after all, who needs them with so many types of semiconductors to choose from. Besides, the FET is supposed to behave like a tube, why not use it.



Bottom view of the transistorized Command Set. The oscillator section of the original Command Set is located on the rear of the chassis. In this conversion the chassis was cut in half and the rear part attached to the front panel.

Hastily I attached an FET to the cathode, grid and plate pin of the oscillator tube. Boy, was I surprised—the oscillator took right off when voltage was applied without any component changes.

Enthusiastically, I began to remove everything from the chassis and decided to cut down its size as detailed in the *Command Set** book. All parts except those associated with the oscillator were removed. The set was then rewired as shown in Fig. 1. The first transistor after the FET oscillator is operated as a class A buffer amplifier to isolate the oscillator from the output transistor and to build up the small signal to drive the next stage. The output stage is a broadband class C amplifier and only draws current when the oscillator is operating. No tuned circuits are used except the original circuit so the output is constant across

*"Command Sets," Copyright 1957 by Cowan Publishing Co., Port Washington, L. I., N. Y.

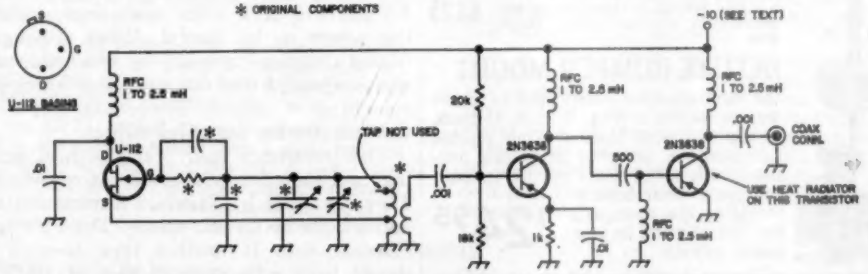


Fig. 1. Schematic of the transistorized Command Set transmitter. All components marked with an asterisk are original Command Set parts. The use of an FET in the oscillator circuit permits a simple and direct conversion from vacuum tube circuitry to semiconductors.

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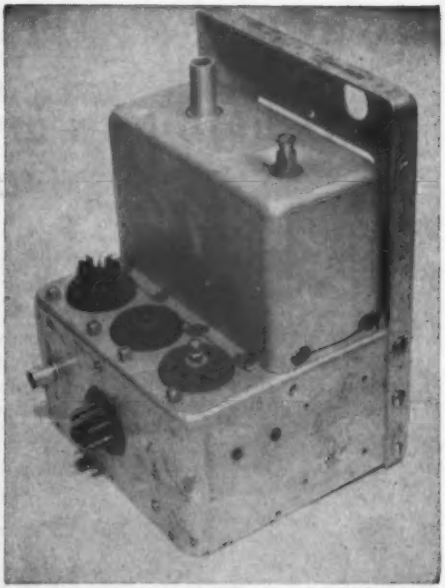
SWAN ELECTRONICS CORP

Oceanside, California



The shortie, transistorized Command Set. The transistor sockets are mounted in the center of the old octal tube sockets.

the band. With a 10 volt supply you get a full watt of input power to the final transistor. This is plenty enough to drive any crystal controlled transmitter.

All the HF Command sets were tried and the oscillator functioned perfectly. I won't attempt to give any of the basic data on converting the Command Sets. This information is quite readily available and would only bore most readers.

To keep the heat dissipation of the final transistor within safe limits, 10 volts is used for the supply voltage. Even with 10 volts a cap type heat radiator should be used. An increase of 2 volts more than doubles the power so be careful. When driving a Gonset Communicater III, for which this unit was designed, I find that dropping the supply voltage to 6 volts is more than ample to drive the transmitter to full output.

The transistors really carry a nice price tag, and should appeal to almost everybody. They are made by Fairchild Semiconductors and sell for about 62c apiece. The FET is a Siliconix unit. If another type is used it should have a transconductance of 1000 or better. If you really like pleasant surprises try this conversion.

. . . K3LCU

SWAN 500

5 BAND—480 WATT SSB TRANSCEIVER
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Frequency coverage of the five bands is complete: 3.5-4.0 mc, 7.0-7.5 mc, 13.85-14.35 mc, 21-21.5 mc, 28-29.7 mc. (In addition, the 500 covers Mars frequencies with the 405X accessory crystal oscillator.)

Along with higher power, improved styling and many deluxe features, the new 500 has the same high standards of performance, rugged reliability and craftsmanship that have become the trademark of the Swan Line. Backed by a full year warranty and a service policy second to none, we feel that the Swan 500 will establish a new standard of value for the industry.

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SWAN ELECTRONICS
Oceanside, California

Charles Landahl W5SOT
121 Barranca Road
Los Alamos, New Mexico

The Dichotomy of a Tube Man

Including the use of a FET in the BC-906 frequency meter.

It is hard to resist a winning combination, particularly when that combination happens to be articles and ads in 73 magazine. The spell-binders referred to are, "Field Effect Transistor Primer" by Jim Fisk[1] and "Two Transistor Testers" by Frank Jones.[2] Couple these with advertisements such as Poly-Paks and Meshna in which you find almost unbelievable semi-conductor and transistor bargains and you are lost.

When such a powerful coalition causes an old died-in-the-wool tube man to become a transistor enthusiast, that is an accomplishment. Would you believe a fellow who buys *two assortments* of 50 new, unused, 20–24 year old tubes for $2.95 per assortment*, just to have them on hand in case? Hold on now, consider what electronic miracles *you* might perform with an orbital beam, hexode uhf amplifier, type 1630, Army Signal Corps Tube VT-128! Just to hold it in your hand and look at it is inspiring. It looks like a grown-up 955 acorn tube, except that it has 12 radial electrode wires instead of five. Into this world of dreams came WHAM, POW, SOT–Fisk and Jones et al.

After the order of solid state goodies arrive, you find yourself impressed by how few identifying marks are on the TO-5 and other style cases. In fact, you reminisce and recall that at least you could peek inside the orbital beam hexode glass envelope and try to guess which is the grid, filament and cathode lead. At this point enter Frank Jones. Build up and use one of his transistor testers and the door of knowledge is opened. No longer do you care if you can't see inside. Everything becomes orderly. PNP's go into one box and NPN's into the other. The duds are set aside for Psuedo-Zener use. The sorting process turns into an exhilarating game. Plug them in, test, pull 'em out. You don't mind that after squeezing the three little wires between thumb and forefinger for the hundredth time, you have an excruciating cramp in the thumb! But wait; now that these wonderous things are sorted, how do you know which of them is "Power", "RF", "IF", "Audio", "Switching" and no test? Frantic thumbing through all issues of 73 from January 1962 forward was of little help for a solution to this new dilemma. In fact it was a hinderance. You find far too many tube articles which you remember wanting to try! Anyway, after having invested so heavily–at least $10 so you can take advantage of the double bonus–it is incumbent upon you to take the next step to find out which of these little three-pronged rascals will oscillate. A circuit to help sort the unmarked transistors further is shown in Fig. 1.[3]

This is a Clapp transistor oscillator, either crystal or series L-C resonated. As shown, the battery and meter are set up for PNP's. Change the polarity to check NPN's. By using several crystals, for example, 450kHz, 2MHz, 3.5MHz and 7MHz or higher, you can learn which of the 100 or more bargain transistors in your possession will oscillate. It sure takes a lot of plugging but it's worth it. Imagine the thrill that shivers through your frame as you hear that crystal clear note in the station receiver. It takes you back to the days when–for old-timers–after you sawed two hacksaw slots at right angles across the bakelite base of a type 76 triode, between the four prongs, so as to decrease the dielectric shunting, you got the

* 1964 Catalog, McGee Radio Company, Kansas City, Missouri.

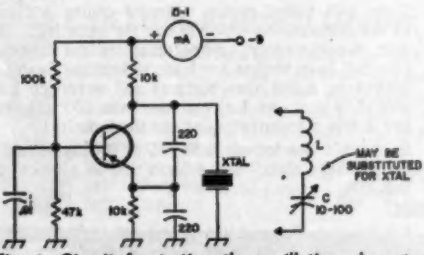


Fig. 1. Circuit for testing the oscillating characteristics of unmarked transistors. This circuit is shown with a negative supply for PNP transistors—for NPN units reverse the meter and use a positive supply.

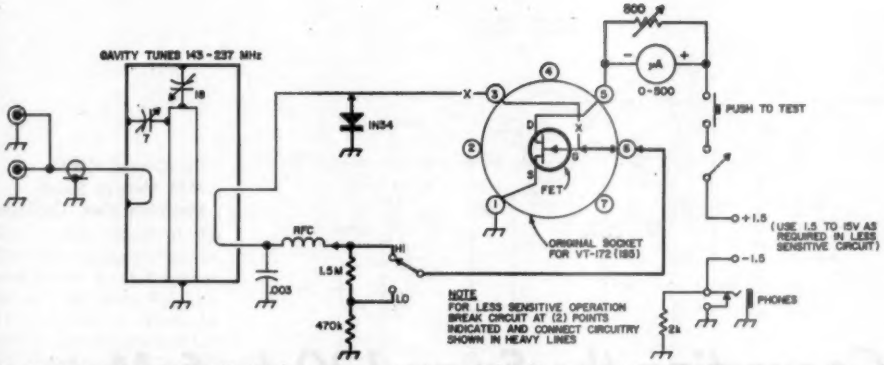


Fig. 2. Conversion of the BC-906 frequency meter to detect rf signals down to a 100 microvolts or so and a field effect transistor. This frequency meter will will tune through both the 2 and 1¼ meter bands.

tube to work at 2½ meters! For the younger man the occasion might be similar to uncorking his first 807 on 10 meters. At any rate, the yield of good oscillators from the packet of 100 bargain items is surprising. Many were vigorous to 7.3MHz. How well they will work in other circuits remains to be learned. It may be safe to assume that some of them will perform as rf amplifiers; how noisy they are can be learned from trial and error unless one uses the more modern transistor testers which are available at much greater cost than the simple ones referred to in this work.

The field effect transistors are indeed fascinating. It boggles the mind to think what would have happened to the radio-radar-sonar systems had the solid state version of the tube arrived first. We'd probably be discovering the vacuum tube about now and that would be a blessing to those of us who need bi-focal glasses in order to work with these miniature components. Jim's FET Primer caused me to try the FET's offered by Poly-Paks. Again, the ones received are unmarked except that one is painted an ominous black. The advertisement seems to say that mine are low noise FET's made by Crystalonics. The package has a nice re-print from 73 and also some data which leads me to believe that one of the FET's is a C-610. Since my surplus BC-906E Frequency Meter had a 1S5 tube which went west, it was a logical choice to go FET. The original and modified circuits are shown in Fig. 2.

The FET can be plugged into the tube socket for experimentation, then later soldered in if you so desire. The schematics show the tube socket pin numbers in which to plug the FET leads. It is necessary to remember that when looking at the bottom of the FET, the *base* lead is where the collector lead normally is located on a standard transistor. (*Not on all FET's. Consult manufacturer's data sheet if in doubt. Ed.*)

The absorption wave-meter with the FET performs much the same as the original tube version. One less battery is required and the battery voltage will depend upon the FET used. The FET which I assumed to be a C-610 works well with 1.5 volts. When the meter reads 500 micro-amperes full scale, the measured drain current is 1.5 milliamperes. As the cavity is tuned through a two meter rf field, the drain current will dip just as it did with the vacuum tube in the circuit.

The sensitivity may be improved by leaving out the 1N34 diode and disconnecting the 1.5 megohm resistor from the end of the radio frequency choke nearest the Hi-Lo switch. These modifications are indicated in Fig. 2 by the heavy lines. Then, with the rf lead from the cavity connected to the gate of the FET, the field effect transistor will act like an old-fashioned vacuum tube with a floating, leaky grid.

With this modification the frequency meter will respond to 100 microvolt signals fed into the cavity by way of the plug-in antenna. The fact that the FET will perform in this manner is a measure of compensation and a bit of solace to a hard vacuum tube man.

. . . W5SOT

1. WA6BSO, "Field Effect Transistor Primer," *73*, December 1965.
2. W6AJF, "Two Transistor Testers," *73*, September 1966.
3. M. S. Kiver, "*Transistors*," 3rd edition, 1962, McGraw-Hill Book Company, New York.

Del Crowell K6RIL
1674 Morgan Street
Mountain View, California

Converting the Swan 120 to 6 Meters

With the continued upswing in sunspot activity, intercontinental DX on 6 meters is just around the corner. This simple and inexpensive conversion will provide a complete SSB transceiver for six.

This conversion makes a complete 180 watt PEP six meter transceiver with more features than the original 20 meter unit and compares favorably with commercial 6 meter units at much less cost.

General description

With the Swan single band transceivers consistently appearing on the used market, the SW 120 models may be purchased for a very reasonable price. This inspired me to investigate the possibility of converting one into a 6 meter transciever. The investigation seemed to prove that this was entirely possible.

Part of K6RIL's shack. The six meter Swan 120 is in the right foreground. The rack on the left contains a kilowatt and transverter for 432 MHz, a 2 kW PEP rig for six and a 2 kW amplifier and transverter for 144.

I noticed that the Swan people left a lot of chassis room in the right hand side around the final section, so I decided to take a chance. A SW 120 was purchased for $85.00 and the modification was started. I was quite amazed at how simple the modification appeared. As described previously, there is a lot of empty space under the chassis for adding extra parts.

New transmitter circuit

The transmitter conversion consists mainly of changing the original driver stage to a second conversion mixer and removing the original driver plate coil and all of the final circuits. The new driver, a 6CL6, operating in class A, and new final with 6146's operating in AB1 were added. In addition, a local oscillator with buffer was installed. These added parts fit into the empty space very nicely. When checking out the transmitter, two major problems were encountered. First,

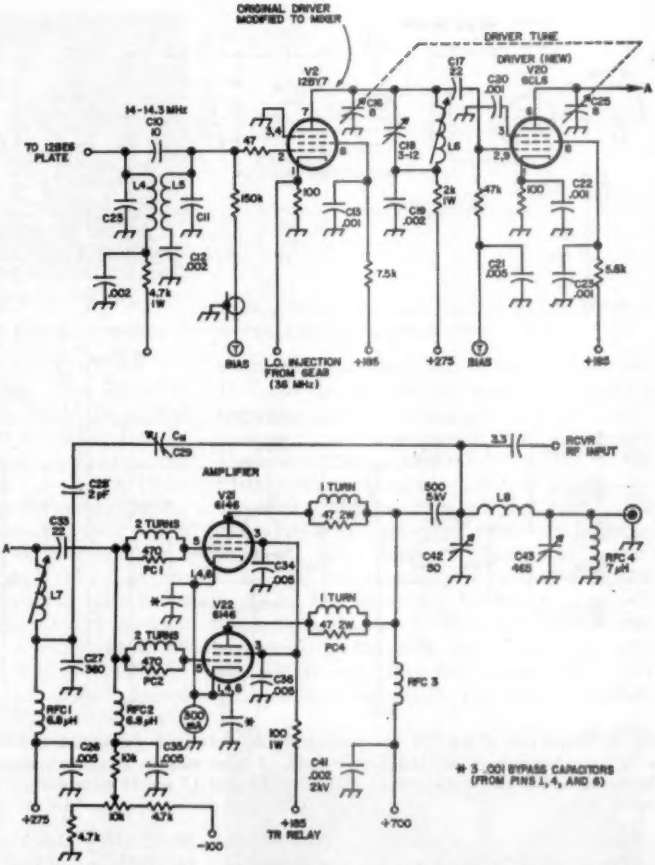


Fig. 1. New circuit of the SW 120 for six meters. L4 and L5 are 8 turns number 26 on a 3/8" form. Relocate L5 and wire as shown. L6 and L7 are 5 turns number 20 closewound on a 3/8" form—use a white slug. L8 consists of 3 1/2 turns of 1/4" copper tubing—1 1/4" inside diameter, 2 3/8" long. Parasitic chokes PC1 and PC2 are 2 turns number 22 wound around a 470 ohm, 1/2 watt resistor. PC3 and PC4 consist of one turn number 14 wound around a 47 ohm, 2 watt resistor. RFC3 is the original choke with 1/4" removed from each end.

the final showed signs of instability even after neutrilizing. This proved to be parasitic oscillations—parasitic chokes in the plate leads cured this problem. The driver was also unstable—the original 11 pF butterfly driver capacitor was used to reduce the cost of modification, but this capacitor produced too much feed back due to the configuration so a new double section capacitor had to be used. Since a small capacitor with low capacity was not available on the market, a small bracket was fabricated and two Johnson type 160-140 capacitors were ganged for this job. This arrangement provides good isolation, takes up a minimum of space and gives more than adequate tuning range.

New local oscillator circuit

A new local oscillator and buffer were installed using a 6EA8. The triode section operates as a standard crystal oscillator with low voltage applied to the plate and the pentode section provides a small amount of gain and acts as a buffer to prevent frequency shift. A crystal switch and five sockets were installed to give additional coverage in the band. The crystal switch also has additional contacts to resonate the buffer coil when the oscillator frequency is changed—this adjusts the buffer output to maintain a constant injection level.

The crystal switch mounts in the hole where the tune switch was originally mounted; this tune switch was completely removed and the wires disconnected. The 12AV6 that was used as an audio oscillator is converted to an AGC amplifier.

Other transmitter changes

The basic exciter was left as original

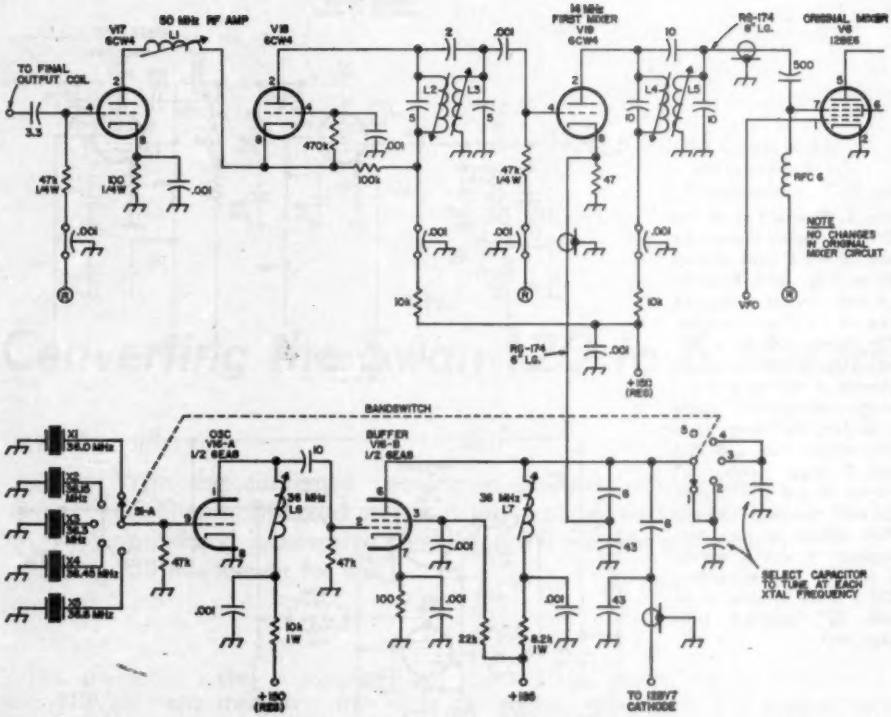


Fig. 2. Conversion of the SW 120 receiver to six meters. L1 consists of 10 turns number 26 closewound on a 1/4" slug-tuned form. L2 and L3 are both 12 turns number 26 closewound on a 1/2" form; L4 and L5 are 30 turns number 30 closewound on 1/4" form; L6 and L7 are 11 turns number 26 closewound on a 3/8" slug-tuned form.

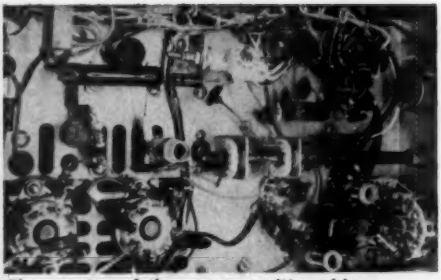
except for the minor changes shown in the carrier balance control and transmit-receive switch. Also, the VFO was adjusted to cover 14.0 to 14.150 MHz to the 12BY7 mixer. This was only done to use a crystal that was available. The original dial calibration was used with the 20 meter markings removed with a pencil eraser (don't use paint thinner). New markings were made to indicate 0-100 kHz and 150 kHz. When calibrated, the dial now can be read to 1 kHz and crystals can be selected to cover any 150 kHz range in the band.

The original driver plate coil with associated capacitors is now installed under the chassis and connected to the grid of the 12BY7 mixer. A 10 pF capacitor is connected between the two coils—this forms a 14 MHz bandpass coupler for added rejection.

Transmitter modification

Before starting the conversion to six, a preliminary check of the transceiver should be made to insure proper operation on the original band. Disassembly is accomplished by first removing all covers and the front panel. Mark any wires that may be disconnected. Follow these steps for removal of the unused parts:

1. Remove the final tube and all parts in the final compartment; leave only the plate and load capacitors and the two stand-off insulators.
2. Remove the 6DQ5 socket, disconnect wires and mark each with the pin number as it is removed. Pull the wires back through the chassis, but leave the meter wires in place.
3. Remove the driver plate coil and the associated wiring from pin #7 of V2 (12BY7) and driver tune (butterfly) capacitor.
4. Check to see that all parts from the driver plate and final grid are removed.



Closeup view of the new transmitter wiring.

The plate meter should also be removed before holes are drilled.

Mark the chassis for new holes by referring to the photos. Holes should be drilled with a small drill before enlarging for the chassis punch; use care when drilling so you don't damage parts left in the chassis. Holes for the crystal sockets require careful layout or much filing will be needed. New holes for the 6146 final tube sockets will have to be cut in the ventilation holes in the bottom of the final compartment. The tubes will now be mounted in the vertical position. Several stand off terminal strips must be installed for assembly of the new circuits; these holes should also be drilled before any parts are installed. When the holes have been deburred and all chips removed, the chassis is ready for installation of new parts.

Transmitter assembly and wiring

The new sockets can now be installed. If the 6146 sockets have no ground lugs, extra lugs will have to be installed. Install the mixer and driver coils as shown in photo—the new mixer coil is mounted under the chassis on an L-bracket. Position the terminals for direct connections. Wiring of the new mixer plate, driver, local oscillator and buffer should be done in sequence starting with the 12BY7 mixer plate. Be sure to leave room for the new driver capacitor and bracket. This capacitor should be installed last—refer to the photos and circuit diagrams for connections and layout. The new crystal switch mounts in place of the tune switch. Assembly of the final output circuit will require installation of a new coil with a better blocking capacitor. Start by installing the original neutralizing capacitor, modified plate choke and original dc bypass capacitor; position the parts as shown in the photo.

Modify the large loading capacitor by disconnecting the front half of the dual section. Use only the rear section. Remove two plates from the rotor and stator of the plate tuning capacitor and install the final tank coil. Use a brass strap from the stand-off to the plate tuning capacitor. Bend a "U" in the blocking capacitor bracket and install the new blocking capacitor. Also use a strap from the plate tuning capacitor as before.

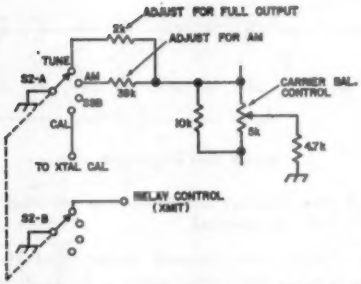
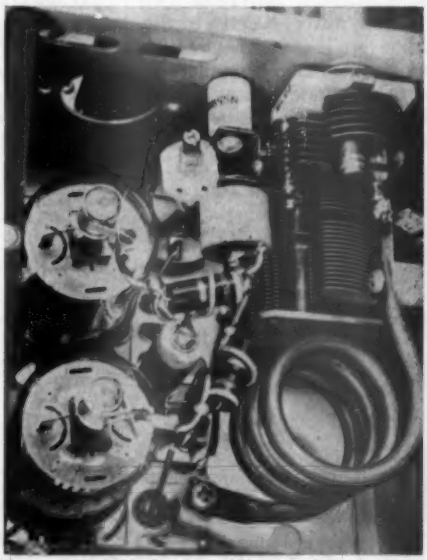


Fig. 3. Wiring the new function switch. S-2 is a double pole, four position rotary switch.

Parasitic chokes must be used in the plate leads or the final will be unstable. Check back through all the wiring to insure that no wiring errors have been made. Be sure all bypass capacitor leads and socket pin grounds are very short. Use neat workman-



The new 50 MHz final amplifier showing placement of parts including the relocated rf choke. The small variable capacitor is connected in series with the original neutralizing capacitor.

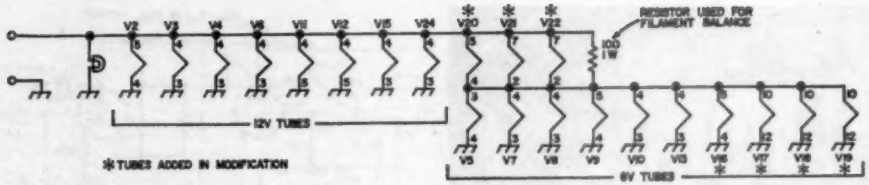


Fig. 4 New filament circuit for the modified SW 120. The tubes indicated by an asterisk are added —all others are original.

ship. Install the second mixer and driver plate tuning capacitor with a bracket, connect leads to the proper coils and install the front panel.

Receiver modifications

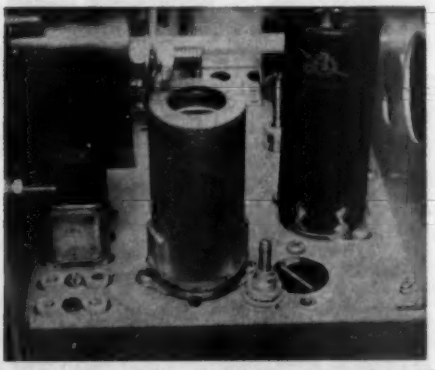
Since no room was available on the main chassis for the new rf and mixer stages, the 6 meter front-end and mixer were built on a small sub-chassis and attached to the VFO housing. This front-end consists of a 6CW4 cascode rf amplifier and a 6CW4 mixer. The local oscillator energy is injected into the 6CW4 cathode across a 47 ohm resistor. A double tuned output feeds the grid of the original 12BE6. The 6BA6 was originally used, but I found that the receiver had too much gain and excessive background noise. By eliminating the 6BA6 (V5) and feeding the first mixer directly to the 12BE6 mixer, the overall receiver gain is ideal. A very weak signal can be copied as well as on the more elaborate equipment I have available. The 14 MHz bandpass coupler must still be used between the two mixers for rejection of unwanted signals. A length of 50 ohm coax is used to couple the local oscillator injection and *if* output. The final output tank also serves as the receiver input. Coupling to the 6CW4 grid is provided by two 3 pF capacitors. On transmit the 6CW4 is cut off by switching bias to the grid as is done in the original circuit.

By referring to the chassis layout and circuit diagram, the new front-end can be built and checked out prior to installation. This completes the receiver changes except for the AGC and audio modifications.

AGC and audio modification

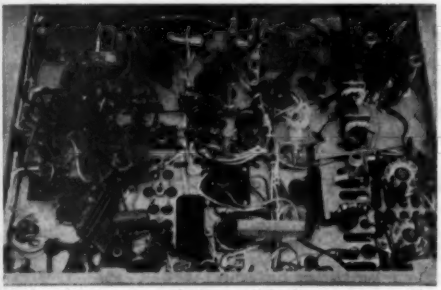
As most persons know, the single band Swan has no AGC circuit or audio level control. With no control to hold the audio level at a pleasant volume, a loud signal blasts the operator out of his shoes before he can get the rf gain turned down. After using the transceiver a few days like this, I decided something had to be done.

In the original SW 120 the 12AV6 (V15)



The new local oscillator and driver tubes and crystal sockets are mounted below the meter. The extra hole in the foreground was evidently punched by a previous owner. Hole in the final compartment wall was for the original final socket.

The 50 MHz front end. The two tubes on the left are the cascode rf amplifier. A 3 pF capacitor connects from the feedthrough on the final compartment to the grid of the rf stage.



Under-chassis view of the modified transceiver. The local oscillator is in the upper right-hand corner, final sockets bottom right and mixer plate and driver center right. The new driver socket is partially hidden by the double tuning capacitor. The AGC circuit is next to the VFO dial plate. The new volume control and power switch are in the upper left-hand corner.

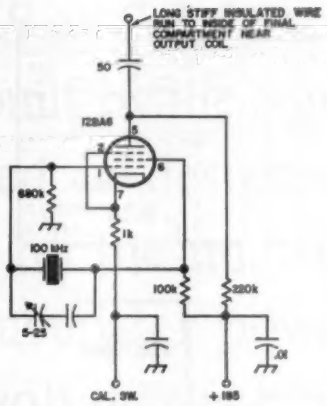


Fig. 5. Circuit of the 100 kHz crystal calibrator for the six meter Swan 120.

is a tune-up oscillator which generates a lot of excessive noise when tuning. This stage was converted to an AGC amplifier. Some early transceivers didn't have this oscillator.

The AGC system used is an audio derived method. The audio signal is sampled from the plate of the product detector and amplified. Finally, it is converted to a minus dc voltage which is proportional to the audio level. This voltage is than fed to the grids of the tubes to be controlled.

In this case the first rf and second *if* stages are controlled with the AGC loop. This allows the rf gain to be run full open. An audio volume control must now be used to adjust the audio level. The original rf gain control was moved to the hole which was occupied by the on and off switch. The new volume control with power supply switch is now in the space left by the rf gain control. Two signals with extreme variations in strength now sound the same level in the speaker and very little popping or distortion is noticed even on loud signals.

The 50k pot marked AGC threshold should be adjusted with the antenna connected-adjust the control to give a residual voltage of -0.3 volts and a little kick on background noise from autos or static.

This AGC circuit works much better than any other version that I tried. I find it hard to give signal reports because most signals now sound the same strength. As stated previously, the quality of the stations received are still very good regardless of the signal level and I wouldn't be without AGC control. This circuit can be adapted to all the single band Swan transceivers whether modified to 6 meters or not.

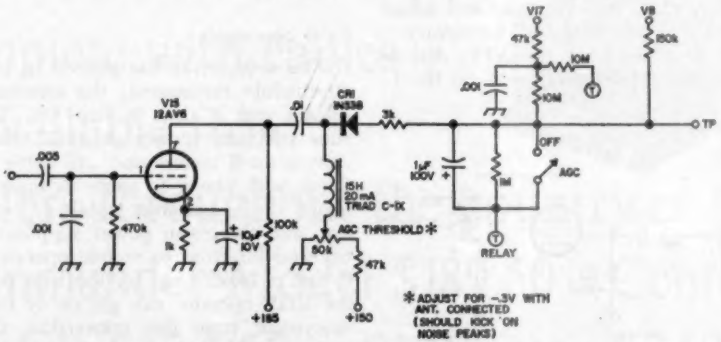


Fig. 6. Audio derived AGC system for the SW 120. This circuit is equally applicable to other single-band Swans.

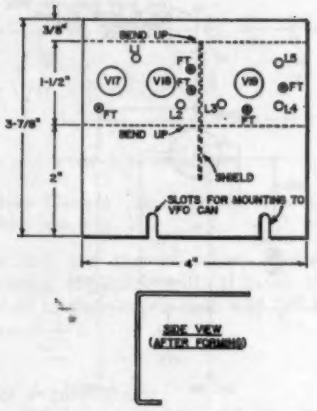


Fig. 7. Chassis for the 6-meter cascode rf amplifier and mixer circuitry.

Miscellaneous changes

A new function switch is shown in the circuit diagram. This will allow the operator to insert carrier for different modes by simply turning the switch. Fixed resistors are selected for AM and tuneup modes.

A calibrator was installed for checking calibration. This switch is mounted in place of the old transmit-receive switch.

Adjustment and operation

Transmitter section

Preset all coils with a grid dip meter, disconnect the final screen and plate voltages, and check to be sure there are no short circuits and wiring is complete. Apply power and with the grid dip meter in the diode position, tune the local oscillator and buffer for maximum output indication. Turn on the transmitter, insert carrier and adjust the mixer and driver plate coils for maximum output at 6 meters. Set the VFO dial to the center of the range and peak up the 14 MHz bandpass coupler for highest level at 6 meters. Connect a voltmeter across the 10k bias resistor feeding the grids of the final tubes and again adjust all coils for maximum voltage on the meter.

Check to be sure the output is on 6 meters. The driver tuning capacitor should be set at near maximum capacitance for the low end of the band—this will allow coverage of 2 MHz or greater range. All coils should be peaked several times to make sure maximum output is obtained.

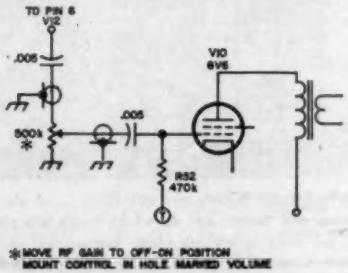


Fig. 8. New audio volume control circuitry.

Neutralization

Connect a detector probe and VTVM to the final output jack. With the screen and plate voltages disconnected apply drive to the final and adjust the final plate and output capacitors for maximum reading. Next adjust the neutralizing capacitor for minimain output. Check to make sure the capacitor is not completely open or closed—it should be in the center range and the output reading low in relation to the original level. Now the screen and plate voltages can be applied and carrier inserted. Peak the driver tuning, connect the output into a good load, and tune up the final to about 230 mA with full drive.

Receiver

The new front-end should be adjusted for maximum gain before mounting to the VFO housing. Only slight peaking is needed for final adjustments.

The crystal calibrator is wired with a lead run into the final compartment and positioned about one-half inch from the final tank coil.

Final comments

This transceiver has proved to be a very worthwhile investment; the reports are excellent and it does a fine job. The final runs the same power as most other transceivers on 6 meters and will drive a 2 kW linear with power to spare. It makes a very handy rig for portable, mobile or just general use, and the Swan power supplies can still be used for fixed or mobile operation. With 6 meters looking up for the next few years, the VHF operator can get ready for lots of enjoyment from this conversion. Get your tools out and get to work.

. . . K6RIL

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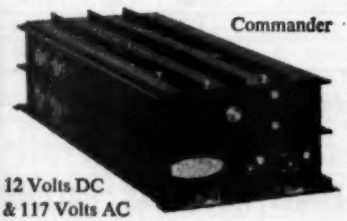

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Military Quartz Crystals for the Radio Amateur

How to find crystal bargains

Surplus military quartz crystals are available at just about any frequency throughout the low and high frequency portion of the radio spectrum. These crystals can be very useful to hams and are available at modest prices from many electronic surplus houses or through some crystal manufacturers and dealers. Surplus crystals can be put to many good uses including transmitter and/or receiver frequency control, band pass filters, frequency standards and many others.

The writer has gathered together a lot of useful data on military quartz crystals and has presented it in tablular form (Tables 1 and 2). The information contained in the tables was derived from the "D" revision of the Military Specification MIL-C-3098, *General Specification for Quartz Crystal Units*. The table does not reference all of the 69, yes I said 69, types of quartz crystals used by the military. Rather, only the more common types frequently found in the surplus markets are discussed.

Military Quartz Crystal Holders

Holder Type	Pin Dia.	Pin Spacing	Holder Height	Holder Thickness	Holder Width
HC-5/U	0.156	0.812	2.205	1.817	1.594
HC-6/U	0.050	0.486	0.775	0.317	0.725
HC-10/U	0.062	N-A	1.055	0.560	N-A
HC-13/U	0.050	0.486	0.775	0.317	0.725
HC-18/U	0.017	0.192	0.530	0.150	0.402

Note: All dimensions are in inches.

Table 1. The dimensions of popular military crystal holders.

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Military Quartz Crystal Types

Item	Military Type	Holder Type	Frequency Range	Oscillating Mode	Freq. Tolerance (%)	Resonance	Drive Level (mW)	Temperature Range (degrees C)
1	CR-15B/U	HC-5/U	80-200KC	Fundamental	±.01	Parallel	—	−40 to +70
2	CR-16B/U	HC-5/U	80-200KC	Fundamental	±.01	Series	—	−40 to +70
3	CR-17/U	HC-10/U	15-25MC	3rd Overtone	±.005	Series	—	+60 to +80
			25-50MC	5th Overtone				
4	CR-18A/U	HC-6/U	0.8-20MC	Fundamental	±.005	Parallel	5-10	−55 to +105
5	CR-19A/U	HC-6/U	0.8-20MC	Fundamental	±.005	Series	5-10	−55 to +105
6	CR-23/U	HC-6/U	10-52MC	3rd Overtone	±.005	Series	—	−55 to +105
			52-75MC	5th Overtone				
7	CR-24/U	HC-10/U	15-25MC	3rd Overtone	±.005	Series	—	−55 to +105
			25-50MC	5th Overtone				
8	CR-25A/U	HC-6/U	200-500KC	Fundamental	±.01	Series	—	−40 to +85
9	CR-26A/U	HC-6/U	200-500KC	Fundamental	±.002	Series	—	75 ± 5
10	CR-27A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Parallel	2.5-5	75 ± 5
11	CR-28A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Series	2.5-5	75 ± 5
12	CR-29A/U	HC-5/U	80-200KC	Fundamental	±.002	Parallel	—	75 ± 5
13	CR-30A/U	HC-5/U	80-200KC	Fundamental	±.002	Series	—	75 ± 5
14	CR-31/U	HC-6/U	1-10MC	Fundamental	±.005	Parallel	—	−55 to +90
15	CR-32A/U	HC-6/U	10-52MC	3rd Overtone	±.002	Series	—	75 ± 5
			52-75MC	5th Overtone				
16	CR-33A/U	HC-6/U	10-25MC	3rd Overtone	±.005	Parallel	2.5	−55 to +105
17	CR-35A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Series	2.5-5	85 ± 5
18	CR-36A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Parallel	2.5-5	85 ± 5
19	CR-37A/U	HC-13/U	90-250KC	Fundamental	±.02	Parallel	—	−40 to +70
20	CR-38A/U	HC-13/U	16-100KC	Fundamental	±.012	Parallel	—	−40 to +70
21	CR-42A/U	HC-13/U	90-250KC	Fundamental	±.003	Parallel	—	75 ± 5
22	CR-43/U	HC-16/U	80-860KC	Fundamental	±.01	Parallel	—	−30 to +75
23	CR-44/U	HC-6/U	15-20MC	3rd Overtone	±.002	Parallel	—	85 ± 5
24	CR-45/U	HC-6/U	455KC	Fundamental	±.02	Series	—	−40 to +70
25	CR-46A/U	HC-6/U	200-500KC	Fundamental	±.01	Parallel	—	−40 to +85
26	CR-47A/U	HC-6/U	200-500KC	Fundamental	±.002	Parallel	—	75 ± 5
27	CR-48/U	HC-6/U	800-3000KC	Fundamental	±.008	Parallel	—	−55 to +90
28	CR-50A/U	HC-13/U	16-100KC	Fundamental	±.012	Series	—	−40 to +70
29	CR-51A/U	HC-6/U	10-61MC	3rd Overtone	±.005	Series	20.0	−55 to +105
30	CR-52A/U	HC-6/U	10-61MC	3rd Overtone	±.005	Series	2-4	−55 to +105
31	CR-53A/U	HC-6/U	50-87MC	5th Overtone	±.005	Series	20.0	−55 to +105
32	CR-54A/U	HC-6/U	50-125MC	5th Overtone	±.005	Series	2.0	−55 to +105
33	CR-56/U	HC-18/U	17-61MC	5th Overtone	±.005	Series	2.0	−55 to +105
34	CR-56A/U	HC-18/U	50-125MC	5th Overtone	±.005	Series	2.0	−55 to +105

Table 2. Operating characteristics of popular military quartz crystals.

The next time you visit your local surplus store on a crystal buying spree, bring along the tables. You will find that they will be very useful as you rummage through the bins.

Table 1 can be used when selecting the crystal type to match a particular socket and vice versa. Table 2 provides much needed information for designing the oscillator circuit of a receiver or transmitter or when trying to select an appropriate crystal oven.

. . . WØHYB

Converting the BC-728

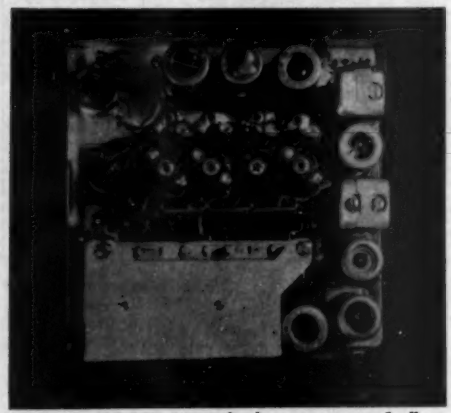
A low frequency superhet receiver for 160, 80 and 40 with a very attractive price.

One of the items you can sometimes find on the surplus market is the BC-728 receiver, a six tube superheterodyne battery operated unit for shoulder carrying. This unit is advertised by several dealers for the amazing price of $7.95!

It is possible, for a bit extra, to buy the units complete with antenna, wet battery and charging cable. This antenna is a good deal if you are going to use the unit for portable use, the most logical application. This plugs into the antenna jack on one side, has a heavy cable with shoulder strap on it and the antenna fastens to the other side of the case. Thus the antenna feedline is used for the shoulder carrying harness. The antenna is telescoping for easy portability.

The case is rugged and most units are waterproof. If you have a selection you might pick out one with a sliding cover over the loudspeaker which would be very handy should you leave it out in the rain on Field Day.

The receiver has four pushbuttons inside to select the received channel. Channel one tunes from 2.0 to 2.6 MHz, channel two from 2.6 to 3.5 MHz, channel three from 3.5 to 4.5 MHz, and channel four from 4.5 to 6 MHz. While this was designed as a fixed channel receiver, you will find that there are tuning knobs right below each push button for tuning the channel. Thus, if you want to use the receiver for amateur use you can tune channel one, with a little padding, to the 160 meter band. Once you have peaked up the antenna and rf knobs you only have to tune the oscillator knob to cover the band.



Inside the BC-728. Note the large amount of elbow room. No crowding like most surplus gear!

Applications

For amateur band reception it is simple to slightly retune channel one for 160 meters. Channel three covers 75 meters as it stands, and channel four can be retuned to cover 40 meters quite easily.

Boating enthusiasts (or friends of boating enthusiasts) will find channel one worth more than the price of the whole unit for it covers the ship-to-shore bands and really brings them in with a wallop.

People having an interest in time and frequency standard signals (astronomy, piano tuning, watch adjustment, event timing, etc.) will find the receiver ideal. Channel one brings in WWV on 2.5 MHz, channel two tunes CHU on 3335 kHz, channel four tunes WWV on 5 MHz, and channel three can be retuned to bring in CHU on 7335 kHz. At least one of these should be available at all times of the day or night.

Conversion

Unless you are interested in wet nursing a wet battery it is a good plan to forget the beautiful vibrator power supply built into the case. This is designed to work with a 2 volt midget wet battery ("Keep upright when charging"). There is also a charging circuit with an external plug to go to a six or twelve volt battery. If you get the charging cable it should come with the battery clips.

Should you agree that dry batteries are

far better than wet (when one is inclined to forget about charging) then you can follow the next instructions. If you are planning to use the receiver for long periods then the wet battery would be a better deal, but for short periods of use dry batteries are ideal.

Step one: remove the power unit. Unscrew all of the bolts you can see coming through the outside case, bottom, top, back, and sides. Open the case and unscrew the knurled screw holding the antenna plug. This plate is also held by two small knurled knuts which will probably take a pliers to loosen. Lift the plate out and let it dangle. Unplug the power plug and gently lift the whole power supply, easing it out of the compartment. There is a little finger that extends into the power supply from the back of the case which will keep the unit from slipping out easily. You will have to work it out. Par for getting the unit out, counting all the screws and antenna plate, is six minutes.

The power unit can be relegated to the "junk box" for possible ravagement on future construction sprees. There are a lot of real nice goodies in it so don't give it the heave-ho.

Power cable

Your choice: remove the power connector socket from the power unit and connect the batteries to this or else remove the plug from the wires and connect them directly. If you decide to deplug the power line then keep track of the wires and connect them the same as you would with the plug.

Batteries

A number 6 dry cell is best for the filaments. They draw 300 mA at 1.5 volts, which will run down a flashlight cell pretty fast. And besides, there is plenty of room for the larger cell. A small 67½ volt portable radio battery will give more power than you need for the B plus and the drain is only 7 mA, so even the small #VS-016 batteries will give good life. You will also need a bias supply. Since there is no current involved here you can use small transistor radio or photoflash batteries. You will need about 7 volts, so a 7½ or 9 volt battery will do fine. Penlight cells, soldered in series are excellent and inexpensive.

Retuning the channels

Once you have gotten the receiver working and have checked out all the channels you are ready to retune. Let us take one specific channel and go through the process. For instance, if we want to move channel three so it will cover the 40 meter band, here is what we will have to do.

Since you will be about doubling the frequency of the channel you will have to remove about half of the windings from the three coils in that channel. Remove the shield can over the antenna coils and cut the connections to coil 3. The four small tongues can be bent back from the bottom of the coil form to release the coil. It is easier to remove turns when you have the coil right out there in your hand. Unwind half of the turns from the terminal end of the coil. Don't be afraid, make it a good generous half or you may have to pull it back out and pull off some more. Resolder the wire end of the coil to the terminal and put the form back into the set. Once the coil is soldered back in the circuit you can make sure you hit the right spot by checking it with a grid-dip meter and tuning the slug to both extremes to find out the new range of the antenna circuit.

Be very careful of the bottom end of the coil for if you should break the wire going from the terminal to the bottom of the coil you will have problems. The coil is wound with every other turn overlapped so that it is extremely difficult to unwind a turn or two from the bottom of the coil in order to give you enough wire to reach back up to the terminal. Better careful than sorry, to coin a phrase.

Step two is the rf stage. This is just as easy as the antenna coil. Do it the same way. There are not as many turns on this coil so you will only have to pull off about 30 turns instead of 40; run it down half way. Dip this one too if you have the instrument. Order a dipper if you don't have one so you'll be in better shape for the next conversion you try. Every ham shack should have a dip meter.

Now comes the p-d-r (piece de resistance), the oscillator. This coil is well shielded and, short of major surgery, you haven't a prayer of getting the coil out to work on. So? So work on it in the set. Warning: be careful. But don't worry, even if you louse everything up you can get back out of the predicament in a few minutes. Clip the wires going to the coil terminals from the set. Then clip the terminal board so that the two terminals are free. Next pry out the circular piece

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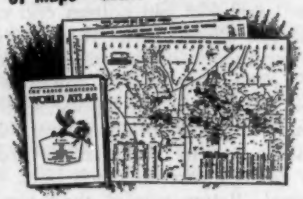

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that keeps you from seeing down into the coil. Watch yourself on this move for you can break off one of the wires of the coil which come through the two holes in the circular piece. The upper terminal (on the rf coil side) is the bottom end of the winding. Lay that over the coil shield out of the way. Now reach down with a midget screwdriver and pull off the tape from the top of the coil. With that off you can unwind the coil turns freely. Pull off 35 turns. If you lose count don't worry about it. You can stop at any time and resolder the wires into the circuit and see where the oscillator is perking by turning on the set. A dipper won't give you much indication due to the coil shield.

When checking for oscillator range it is handy to have a signal generator on hand. This is another pretty basic piece of test equipment for the well run ham shack. Lacking this basic unit you can always tune in a distinctive signal and hunt for it on your regular all-wave receiver. Good heavens, don't you even have that?

When you are all through pruning the coils it wouldn't hurt any to paint on a bit of coil dope to hold them together.

What's that Elmer? You say you broke the wire on the oscillator coil and don't know what to do. Well, in that case you can pull off all the wire from this coil and scrape the form as clean as you can. Then you wind up a new coil for yourself out of #31 enamel covered wire (or #29, 30, 32 etc.) and slip it over the form, holding it in place with the aforementioned coil dope. About 35 turns should do.

Antenna

The AN-75-C antenna, which was designed for the BC-728, is the best deal, but you may have some trouble locating it. For some obscure reason the antennas seem to have gone one way and the receivers another, though both are available in quantity. Should you decide for one reason or another to do without the AN-75-C you can get fine results by connecting a short length of wire to a Motorola type plug. Fifteen feet works well. You can coil this up and carry it inside the set when not in use and then fling it up into a nearby tree or house for operation. Or you can put a clip on the end of the wire and connect onto more ambitious wires. When changing antennas remember to open up the set and retune the antenna circuit for maximum volume. ■

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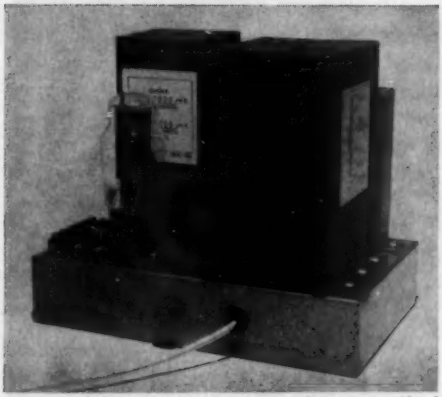
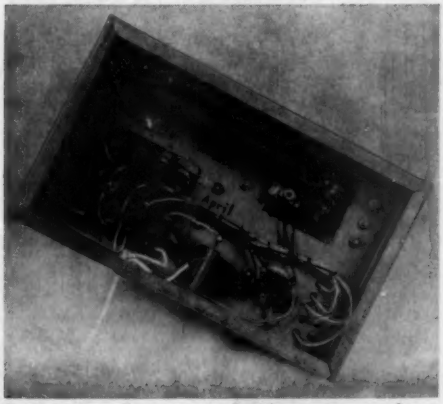
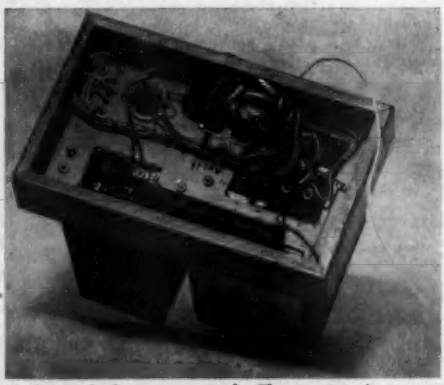


Power supply. The picture was taken with Ilford Pan F film in the 4 x 5 inch camera. There was one spotlight overhead.



Bottom view of power supply. The camera used was a Cannon FX with a 50 mm lens. Photofloods in reflectors, no diffusion. Tri X film.



Underneath the power supply. The 4 x 5 inch camera was used, with diffused lighting.

Practically every article in radio publications uses at least one photograph. Some of these are good, some are excellent—but a lot of them are poor. Yet I have never seen an article on how to photograph equipment properly, so here goes.

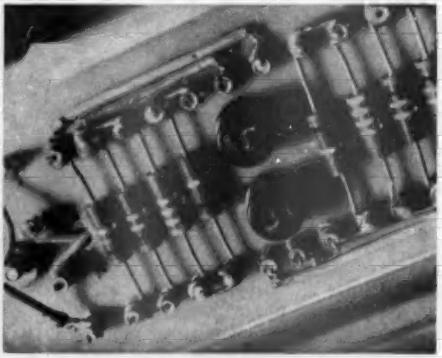
The amateur writing about his electronic gadgets is naturally going to use whatever camera equipment he has. If he did have a choice of equipment what would be best? A large view camera with tilting front and back, even if it is an old one, is tops; with this he is able to correct converging verticals.

The professional photographer uses a 4 x 5 or 8 x 10 inch camera, but it is possible to take good photographs with a box camera. A tripod or camera stand is a must, the heavier and sturdier the better.

Almost any lens will take a good photograph when closed down, as it should be to get everything in focus. For the small camera a long focus lens is best, except for detailed close-ups.

Lights don't need to be elaborate; photofloods in reflectors, reflector floods and even an ordinary lamp hand held is quite usable, as is the ordinary room lighting. Flash lamps

Balanced transistor amplifier for photovoltaic cell light meter. This shot was taken with a 4 x 5 inch camera.



Closeup of a balanced transistor amplifier. The camera—Edixe reflex, with a Novoflex 35 mm lens. Tri X film.

aren't very good and electronic flash isn't much better unless you really know what you are doing.

As the camera should be on a stand or clamped to something solid, fast film isn't necessary. For a small camera slow, fine grain film usually makes a better enlargement, although some of the newer fast films, such as Kodak Tri X, are excellent. Don't forget the exposure meter; most camera users have one and should know how to use it.

If you are using a view camera, don't forget that a close-up photo requires more exposure. See your camera manual regarding this. This is needed because of the additional bellows extension.

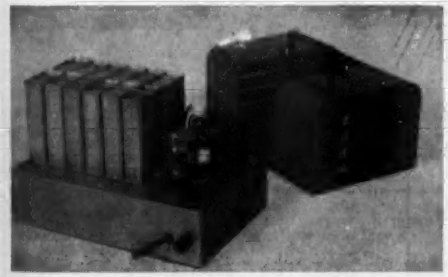
For a background, use a white card or unwrinkled white paper available from art supply houses.

Most editors like a large print, preferably 8 x 10 inches, so an enlarger is needed unless a friend or drug store is making the prints.

Reflectors to lighten up shadow areas may be white cards or even a newspaper and some diffusing material such as tracing paper or cloth, although glass cloth is the preferred material.

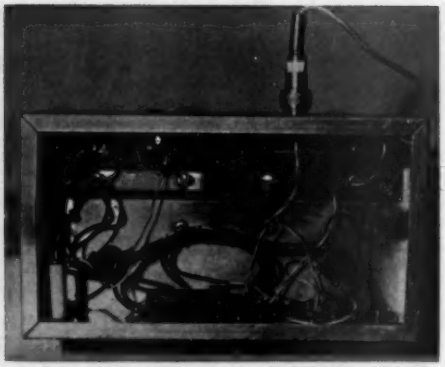
Looking over a number of radio magazines the most common faults in the photographs seem to be blurring, probably due to improper focusing or movement of the camera; and brunt out faces, due to having a flash on the camera too close to the subject. We musn't rule out poor engraving and printing, over which the photographer has no control. However, if the prints submitted aren't overly contrasty or soft and mushy, but are sharp and have a full range of tones from lights to darks, the chance of good reproduction is good.

Which brings up to the subject of process-

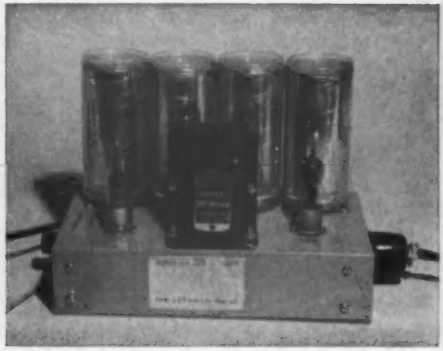


High voltage flash unit, with protective cover. A 4 x 5 inch camera with two diffused lights was used.

Inside view of the high voltage flash unit. The large connector is used because of extremely high currents which may peak at 800 amperes at 2500 volts. Definitely not for the beginner.



Inside the 50 watt second power supply. This supplied the power to take this photograph. The light was harsh, undiffused.



The flash for this photograph was provided by the low voltage power supply pictured. 4 x 5 inch camera used.

ing. The film and paper manufacturers have spent large sums of money working out the proper processing for their materials, and are anxious to have you get the best results possible. They should know what's best for their products, so it's a good idea to follow the instructions in the package.

To sum up. First, have a good solid support for the camera. Take the time to arrange the subject. Try a number of angles. To be sure of the best exposure; take a few extra shots at different speeds—film is cheap.

If possible use a lens of longer than "normal" focal length to get better perspective and possibly a short focal length lens for very close up shots. Use a small aperture for greater overall sharpness and use fine grain film if you are using a small camera.

Avoid harsh lighting, and over or under development of the film. Make a print on glossy paper with full tonal range. The editor likes lots of pictures.

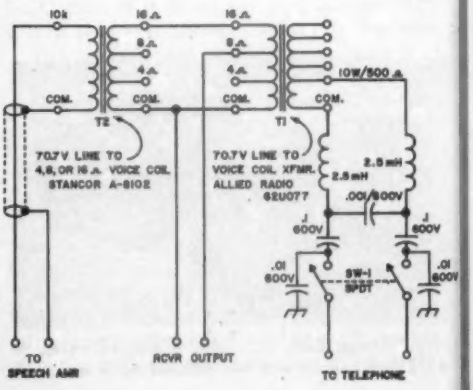
As the great majority of my work is done with large cameras, and as they were available and I feel more at home with them. I used a couple of Speed Graphics, one with a 127 mm Ektar lens, the other with a 135 mm Zeiss Tessar lens. There is no discernible difference in results. I also used a Cannon FP Reflex with a 50 mm and 135 mm lenses and an Edixa Reflex with a Noflexar 35 mm lens, which will focus down to about two inches from the object.

For the 4 x 5 cameras I used Ilford FP3, a fine grain film; for the 35 mm cameras I used Kodak Tri X film and IlfordPan F, an extremely fine grain film. I imagine the editor would find the Tri X acceptable, although fairly grainy. I doubt if this would show when printed. ■

Why Fight Ohm's Law and Lose?

An article by K5HPT in the October 1963 issue of 73 described a simple phone patch. The title was "Why Fight Ohm's Law?" Well, I did—and lost. It was a big hum of a mess. So John WA4CUA and I experimented and came up with the circuit shown. I used two transformers back to back and added rf bypassing. I have had several requests for a drawing of the patch by those who have heard it on the air.

. . . Roger Williams WA4KWC



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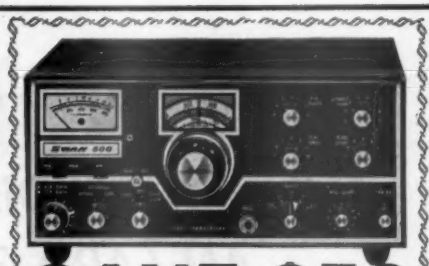

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Panoramic Display from the AN/APA-38 Indicator

A simple, low cost approach to panoramic reception.

A very attractive item for the VHF enthusiast is the AN/APA-38 panoramic indicator. It is an earlier version of the IP-69/ALA-2 indicator whose conversion was described in the June 1964 issue of *73 Magazine* and is currently available for under $20.

The APA-38 was originally used with the APR-1 and APR-4 receivers for identifying radar signals. Basically it is a superheterodyne receiver whose output is a video signal applied to the vertical plates of a cathode ray tube. The input center frequency at 30 MHz is heterodyned to the 6.5 MHz *if* by a sweep oscillator. The frequency limits of the sweep oscillator are controlled by the sweep width control—at its maximum position the indicator will display the spectrum ± 5 MHz of the center frequency.

In addition to the conventional panoramic display, two sweep positions are provided. These sweep ranges (PRF-1 and PRF-2) cover 30 - 1500 hz and permit using the indicator as an oscilloscope for analyzing the modulation of the incoming signal.

Since the indicator was orginally designed to operate from a 400 Hz supply, it must be converted to 60 Hz operation. To do this remove the following components: power transformer T-104, high voltage rectifier V-105, low voltage rectifier V-110, and choke L-101. While you are at it, remove the front panel and the power supply cage.

Sam's neat rack-mounted panoramic indicator. Although the center frequency of this unit is 30 MHz, other *if* frequencies may be used with a simple heterodyne converter.

The 60 Hz supply could be built in the space made by removing the 400 Hz components. However, building it on a separate chassis not only makes construction simpler, it reduces the AC coupling problem and shortens the unit so that it will fit into a 16 inch deep rack.

Build the supply as shown in **Fig. 1.** The need for a special oscilloscope transformer was eliminated by using a voltage doubling circuit for the CRT negative high voltage supply.

Replace the old front panel with standard 8-3/4 inch rack panel. The CRT viewing hole is easily cut with a saber saw. The power supply should be mounted to the panel with a bracket and supported with a shelf. The rf input connector is replaced with a BNC type mounted on the rear of the power supply chassis.

After wiring the power supply, check the indicator for proper operation. Allow it to warm up and advance the brilliance control until a trace is visible. Set the function switch to PAN. Turn the gain control fully clockwise and position the trace along the base line using the horizontal and vertical position controls. Sharpen the trace with the focus control. Couple the output of your signal generator (or grid dip oscillator) to the input connector. With the sweep width control fully clockwise, tune the signal generator from 25 - 35 MHz and observe the pip. Set the signal generator at 30 MHz and center the pip using the center control frequency. The height of the pip should be reduced with the signal generator attenuator until it is not over-loading the display.

Modulate the signal generator with a 400

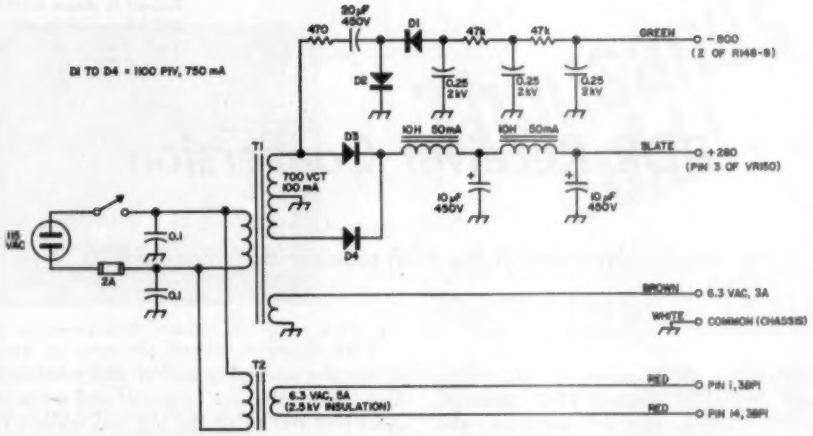


Fig. 1. An AC power supply for the converted AN/APA-38 indicator.

Hz signal. Place the function switch in the PRF-1 position and adjust the sweep control until the signal locks in, and the modulating sine wave is stationary on the CRT.

The indicator is now ready for use. Couple the 30 MHz *if* of your receiver into it and you are ready to go. If you have an *if* other than 30 MHz you can construct a simple heterodyne converter to convert it to 30 MHz.

On the air experience is the best way to become familiar with the operation and uses of a panoramic display. The following is a brief guide to signal identification:

1. A CW or unmodulated carrier appears as a pip of fixed height. If it is a keyed CW signal the pip will appear and disappear with the keying. With a little practice you can copy CW visually!

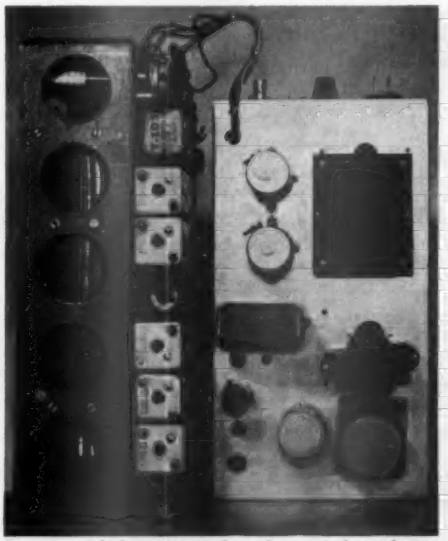
2. AM signals will appear as a pip of fixed height when no modulation is present. With low frequency modulation the waveform will look like a broad response curve. As the frequency of modulation increases you can observe the sidebands moving away from the carrier.

3. SSB two tone test signals appear as two carriers of slightly different frequency. If the tones are closely spaced they will generally appear as a single deflection varying in height.

4. An MCW signal will appear like a CW signal, varying in height as the transmitter is keyed. If the modulating frequency is high it will be possible to distinguish the sidebands.

5. An FM signal appears as a multitude of discrete pips. The amplitude of the pips is a function of the modulation index. The spacing between pips is a function of the modulating frequency.

. . . W6JTT



Top view of the converted, rack-mounted AN/APA-38 panoramic indicator. The surplus unit is on the left, and the new 60 Hz power supply is on the right.

Robert E. Ream K3HIL
200 Wynwood Road
York, Pennsylvania 17402

RDR Receiver Conversion

A simple conversion of the RDR receiver to cover the 220 MHz band.

Conversion of this receiver to AC operation with crystal or external VFO operation is a worthwhile project for the ham who wants to listen in on the 220 MHz amateur band.

Remove the chassis from the cabinet by loosening the twelve screws around the front edges. Pull out the chassis and by depressing the tabs on the sides, completely remove it from the cabinet. Now, remove everything from the dynamotor compartment, including all wiring, the fuse holder and base by removing four screws along the outside edges. Remove the cover from the crystal and intercontrol compartment by removing fourteen screws. Pull out the crystal oven and oven socket, leaving the two heavy wires as long as possible.

Remove all the automatic tuning system except the multiplier and rf dial mechanism. Also remove the two long rods and associated gears that run along the top and bottom rear of the compartment—this has a short shaft coming straight out the front in the middle of the compartment. Add a coupling to this shaft so it will protrude through your new panel and you will be able to tune both the multiplier and rf controls simultaneously.

Cut out a 5 by 12¾ inch panel to mount where the former oven, rf and multiplier cables were covered. Cut out holes for the multiplier and rf dials—also the tuning control, crystal socket, B+ switch, AC switch, pilot light and speaker. Cut a panel 6¾ by 10 inches to fit the dynamotor compartment; this is for the new power supply. Wiring is simple, as all parts are labeled. Cut out R112 on top behind the front panel. The transformer filament windings go to terminal

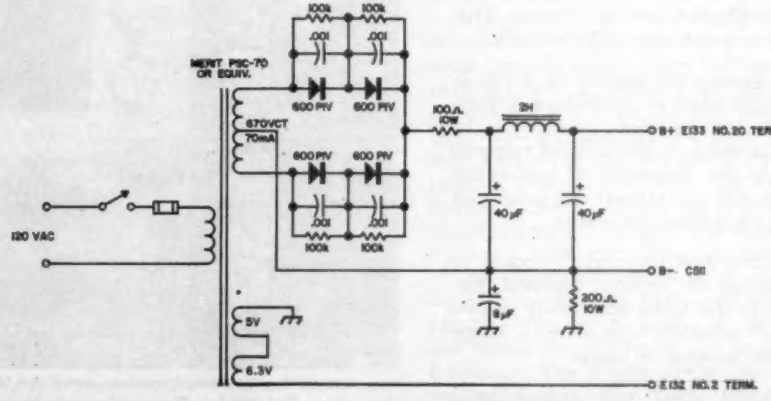
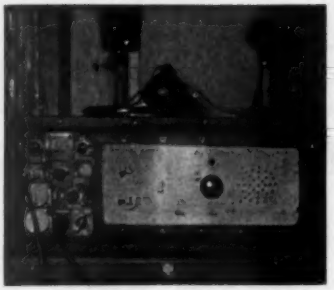


Fig. 1. AC power supply for the RDR receiver. The completed supply is mounted on a small panel which is mounted in the original RDR dynamotor compartment.



K3HIL's converted RDR receiver. Bob used a 4937 kHz crystal to cover the Gemini astronaut's 296.8 MHz communications frequency.

number 3 on terminal strip E132. The other end of the wiring goes to ground.

Label original pilot light connections for future reference. The B+ connects to terminal number 20 on terminal strip E133. The B- is connected to C511 on the back end of the multiplier section. The speaker and output transformer are connected across the phone jack terminals under the *if* strip cover. Install a crystal socket (FT243) on the front panel and connect it to the two heavy wires going into the multiplier stage. Install the switches, pilot light and speaker on to the panel—now you're ready for the smoke test.

Tune the receiver as follows: insert the crystal, rotate meter switch to position 1, unlock multiplier dial and adjust for a reading of 5 to 7 on the meter. Turn the meter switch to position 2, readjust multiplier slightly to obtain a reading of at least 4 on the meter. At position 3 unlock the rf dial and rotate for maximum noise and a minimum reading of 7. Position 4 is the plate voltage of receiver—normal reading 7; position 5, filament voltage, normal reading 7.5. The other positions are not used.

Crystal control was desired in my case but the multiplier tuning capacitor has a rather large range which can be used to tune the oscillator. The crystal frequency is doubled, then tripled 3 times—a total multiplication of 54. The *if* frequency is 30.2 MHz.

To determine what crystal frequency you require, subtract 30.2 MHz from your desired receive frequency and divide the result by 54. For example, to receive 222.5 MHz, 222.5—30.2=192.3 MHz. Dividing by 54: 192.3/54 = 3.561. A 3561 kHz crystal would be required.

. . . K3HIL

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This shortened dipole is little longer than a 20-meter quad.

A few months ago I built a wooden tilt-over tower, which to my amazement, worked very well. After I completed that project, I worked a few more weeks looking for parts for my "Triband Quad" to put on top. Up to this time I had been using, and very successfully, an all-band antenna.

With the erection of my "Triband Quad" I found that I could not keep the all band antenna up anymore, because there was some interaction with the quad and I could not get the SWR down when the quad was pointed in the direction of the other antenna.

I had to come up with something that I could put up that would not interfere with the quad. My property is not too wide, but it is long. If I put up a dipole it would run in the wrong direction to be effective. To put a half wave rotatable dipole up was out because I could not get past a nearby tree, mostly in my neighbor's yard. Hence, this shortened version of the 40 meter dipole.

I needed a plate to attach my quad to the mast, and I knew where there was one, which I bought for five dollars. The owner also threw in the rest of the antenna which had come down in a wind storm. After careful observation I noticed that the driven element was in good condition, and that it could possibly be placed in between the quad.

I figured that by placing a bamboo pole into either end and by taping a wire along the pole, it would work but again it could not be over 30 feet. The commercially built four band beams have a 40 meter section close to 39 feet.

Electrical

Fig. 1 shows the idea of the dipole. It consists of a ten meter section of an old driven element—a coil attached to the end of it, and a length of wire attached to the coil, that will resonate at 7.1 MHz.

There are several ways to construct the antenna at the mast. It may be done as seen in **Fig. 2**, or a dowel may be used as an insulator and the aluminum may be placed over the dowel. Any other way may be incorporated as long as there is a space between one side of the antenna and the other; also one must remember to keep it electrically insulated from the mast.

The length of the wire was 19 feet at the beginning. I also started with 20 turns of 3" coil. My first job was to get the one leg to resonate at 7.1 MHz. This was done by winding four turns of soft drawn wire around a grid dip meter and finding the right spot on

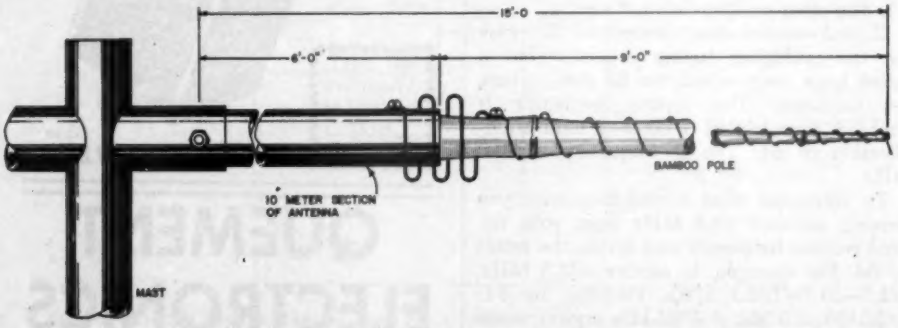
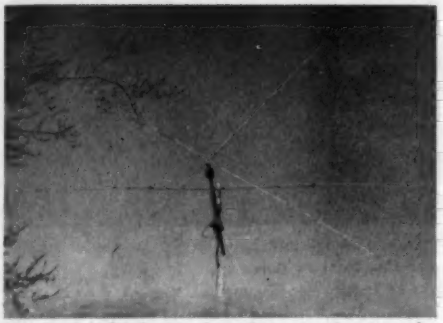


Fig. 1. Construction of one arm of the shortened 40-meter rotatable dipole.



Here's the dipole in place between the two elements of the quad.

Fig. 2. One way to connect the antenna to the mast.

the coil. See **Fig. 3** The next step was to wind the wire very carefully around the bamboo pole so that each turn was about 1" apart. I did this until the 19' were completely used up. I checked the grid dip meter again to make sure that there was no change in resonance, and there was none.

At the coil I began moving the tap so that I would add two or three turns to the coil, while I snipped the wire at the other end to resonance. You may leave the 19' of wire on the pole. You may also make it shorter by adding more turns to the coil than I did.

Attach the coil with two stand off insulators so that the bamboo pole is approximately in the center of the coil. After I found the length of the dipole I wanted, I soldered the wire to the coil, and I drilled a hole at the end of the bamboo pole, and put a small nut and bolt through it. To this I attached the other end of the wire.

That being completed I did exactly the same thing to the other leg. Knowing the approximate number of turns on the coil, and the number of turns on the bamboo pole it took half the time to fix the second side. After completing the second side I put two coats of varnish on the bamboo poles and over the wire, I coiled over the bamboo pole.

Now that I had both sides completed, I again checked resonance by placing the coil around the grid dip meter, but this time the wire was attached to either side. See **Fig. 4** The meter should dip as you move it through the coil without any further adjustments.

Feeding

Feeding the dipole may be done three ways. One, feeding it with balanced twin lead as I did; two, feeding it with 72 ohm coax; or three, any other feed line with a balun. Make sure the feed line runs away from the antenna at a right angle as much as possible. I have mine running right to the ground, a total of 38' before it comes into the shack, where I tune it with a match box.

The SWR seems to rise sharply toward

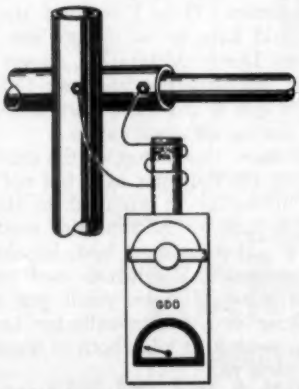


Fig. 3. Getting one arm to resonate at 7.1 MHz.

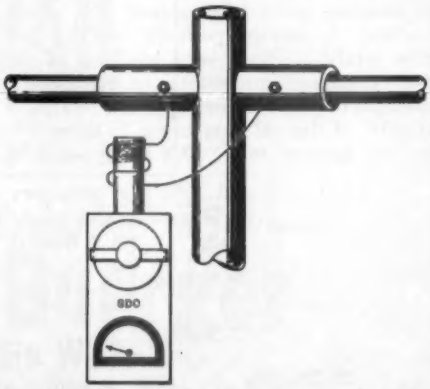


Fig. 4. Checking the resonance of the whole dipole.

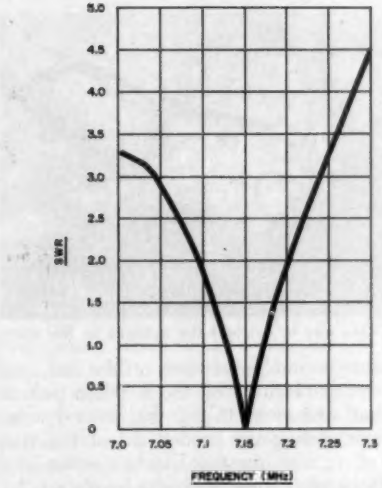


Fig. 5. SWR of the antenna fed with balanced twin lead through a Matchbox tuned at 7.15 MHz and the transmitter frequency varied.

the high end of the band. See Fig. 5 I have found that I can get a one-to-one reading at the transmitter using RG86/U 205-ohm balanced line.

Performance

I found that the quad works perfectly without any interaction between it and the dipole. Don't try to feed the dipole with the same feed used with the quad; it will not work. You must use a separate feed line.

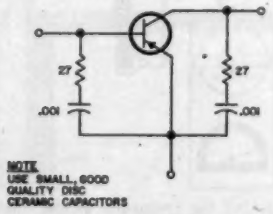
Here's what the coil between the ten meter section and the bamboo pole.

I also found that there seems to be a slight gain in strength when the dipole is at a slight angle to the person you are working. I have had one DX contact in Venezuela with a 5 x 7 report. I have held my own through the QRM on 40 meters. It's not a cure-all by any means, but it beats not having any antenna at all on forty. Also you can rotate it along with your quad. Its weight is relative to the weight of the quad. As you can see, I have it up on a wooden tower and it seems to be holding up fine. All in all, I would say it should cost you about $5.00 at the most to build.

Good luck and hope to hear from you on 40 meters.

Is Your Heathkit Transistor Tester Running Wild?

The scene was an industrial electronics laboratory, not so long ago. Our Heathkit Transistor Tester Model IM-30 had been absorbing a considerable amount of skilled engineering talent for almost the entire morning. It seemed perfectly healthy, but gave erratic readings on a batch of expensive new silicon transistors. As the general atmosphere was becoming rather warm, a little bit of the old light began to dawn . . . Do you suppose this XXXX thing could be oscillating? It turned out the oscillations could be stopped by applying a fingertip to one transistor lead. The tests were rapidly completed and with a loud roar the focus of attention turned elsewhere.



Recently, I almost failed to recognize this same problem while checking some surplus 25c transistors. Then I realized the difficulty would have to be worked out. Using my James Dandy Mixer (73, August 1966) I spotted the oscillation at about 130 MHz. And after one or two false starts I found an appropriate circuit modification.

Fig. 1 shows how I stopped the oscillations by loading the transistor at rf but not at dc. The components are installed in the best VHF style close to the transistor socket. An extra test socket on short leads required the same treatment although it is used with the modified tester. I hope you'll put in the emitter-base and emitter-collector branches first time around! It takes both of them to do the complete job.

. . . James Ashe W2DXH

"HAM" BUERGER'S

June Specials . . .

Astatic GD-104 desk type push-to-talk microphone and stand. Regular price **$51.20.**

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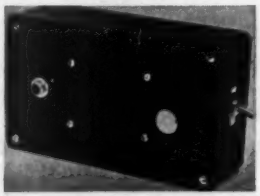
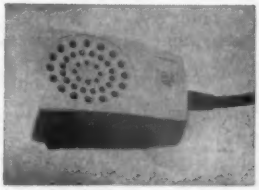
Special price $12.95



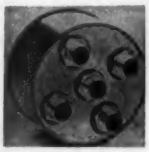
AJ-1 Audio Filter. Ideal for CW and SSB transceivers. Variable audio range. 28 dB down at 100 cps —peaks 200 cps. 4 ohm input and output impedance, built-in in and out switch. 6¼" L x 3¾" W x 2" D.

Special $7.95



Astatic mobile ceramic microphone. Super talk power. Regular price **$12.75. Special price**

$6.50



CO-4 4 Position Coaxial Antenna Switch. Uses low loss connectors and a ceramic switch. Complete with knob. Regular price **$9.95.**

Special price $6.95

CO-2 2 Position Coaxial Antenna Switch. Same construction as the CO-4 switch to the left. Used for switching linear amplifier in and out of the antenna line. Regular price **$8.95.**

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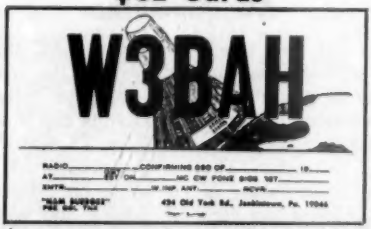

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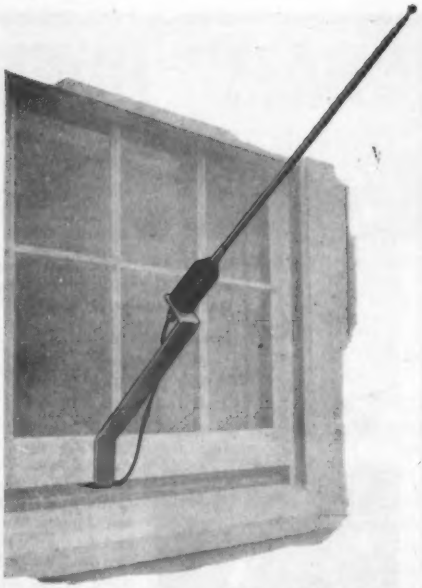
The Vacationer Portable Antenna



How often when checking into a hotel or motel for the night, or if you live in a non-cooperative-landlord apartment, have you wished you could get on the air without causing an upheaval? Well now you can: The Vacationer Portable Antenna is the answer.

The Vacationer Antenna is unique in the fact that this base loaded whip becomes a center-loaded antenna with very low SWR due to the simple wire counter-poise that is clipped onto the window mount and extends inside the room. Places are indicated on the counter-poise wire for the best match on each band. If an SWR meter is inserted into the line, it is possible to get a 1:1 ratio easily.

For use on 20, 15 and 10 meters, suitable loading coils are provided, and are attached to the base of the whip with removable screws. For two and six meters a shorting bar is furnished. The Vacationer is ruggedly constructed. The base is of molded unshatterable nylon; the machined parts are made of nickel-plated brass, and the window mount is weather resistant aluminum.

With this portable antenna, going together quickly and easily, one can be on the air in less than 5 minutes. It is designed to handle any of the 300-watt PEP transmitters, or 180 watts AM or CW.

Come hurricanes, sleet or ice storms, when beams and outside dipoles collapse, The Vacationer, as an emergency antenna, will keep you on the air; very economical insurance. The Vacationer folds down to 19 inches, so it can be packed in a suitcase, it is sold by the DPZ Corporation, P.O. Box 1615, Jupiter, Florida, 33458, and retails for $24.50.

. . . K1RA

AC Ammeter

Have you ever wondered just how much current that transmitter is pulling from the 120 Vac line, but don't want to get into the expense of a good AC wattmeter? Here is a low cost adapter for making such power measurements with an AC voltmeter. The voltmeter should have a sensitivity rating of at least 1000 ohms per volt. Almost any vom or vtvm in the shack should meet this requirement.

The adapter consists of an accurate 1 ohm power type resistor mounted in a ventilated housing provided with terminals for connection to the AC line, voltmeter, and power consuming device. This resistor converts the voltmeter into an AC ammeter. At any deflection of the voltmeter the reading is directly in AC amperes. To convert to watts drawn by the load, multiply the deflection by the line voltage. Example meter reads 0.65 volts and line voltage is 120 Vac. 0.65 x 120 = 78 watts. This is only accurate for a resistive load, but will give a relative reading on others.

Above 500 watts the voltage drop across a 1 ohm resistor becomes large enough to reduce the voltage applied to the device under test. If higher power levels are to be measured, the resistor should be reduced to .5 or .25 ohm.

DC power drain can be measured by substituting a DC voltmeter in place of the AC voltmeter.

. . . Don Marquardt K9SOA

Gordon E. Hopper W1MEG
75 Kendall Avenue
Framingham, Mass. 01701

Operating the BC-611 Walkie-Talkie

BC-611's are now available and are very useful for short-haul communications and locating sources of intereference.

The BC-611 is a press-to-talk portable radiotelephone designed to transmit and receive signals over the frequency range 3.5-6.0 MHz. Its range is short because of its low power (¼ watt output), and could be anything from 100 feet to one mile. Over salt water, a three mile range might be obtained. These units are currently available and are being used for short haul work in the MARS circuits.

Power requirements are 1.5 Vdc for the filaments and 103.5 Vdc for the B plus. Originally, the batteries were designated as BA-37 (1.5V) and BA-38 (103.5V). Either the Burgess XX69 or the Eveready W361 are commercial equivalent B batteries but the 1.5 volts may be obtained from two flashlight C cells in parallel and an FT-501 adapter.

Extension of the telescopic antenna to its full length actuates a toggle switch to energize the unit. The receiver is a superhet circuit and contains a crystal controlled local oscillator. The transmitter section consists of a crystal oscillator, power amplifier, speech amplifier, and plate modulator. All of the tubes except one serve double purposes. Tube VI (3S4) serves as the rf amplifier in the receiver and as the power amplifier in the transmitter, tube V2 (1R5) functions as the converter-oscillator in the receiver and as the oscillator in the transmitter, tube V4 (1S5) operates as the second detector–avc–af amplifier in the receiver and as the microphone amplifier in the transmitter, and tube V5 (3S4) serves as the output amplifier in the receiver and as the modulator in the transmitter. Tube V3 (1T4) operates as the *if* amplifier in the receiver.

The push-to-talk switch is a 7-section, double-pole, double-throw switch. Some of the surplus units may be received with broken switch handles. It is possible to fashion a new switch handle made from a piece of plastic.

The transmitting frequency is determined by the particular crystal used; to receive stations operating on the same frequency it is necessary to use a receiver crystal 455 kHz higher than the transmitting crystal frequency.

To tune the receiver for maximum performance on a specific frequency, adjust C7 and L2 for best reception of a received signal. There are two methods for tuning the transmitter's output. The best way is to use a field strength meter and adjust C12 for maximum meter deflection. The second method is to insert a milliammeter in the plate circuit of the rf power amplifier (remove jumper inside bottom cover and insert meter) and adjust C12 for maximum meter deflection (dip).

The BC-611 is part of Radio Set SCR-536-A, -B, -C, -D, -E, and -F and the technical manual is TM 11-235. The test set for the SCR-536 is designated as Test Unit I-135. Loop antenna AN-190 (not supplied with the unit) is a directional loop antenna with a built-in sensing device and can be used for homing purposes in conjunction with the BC-611. When equipped with the loop antenna the BC-611 should make an excellent unit for tracing down local interference sources and should appeal to amateurs possessing fixed direction finding equipment.

. . . W1MEG

Wilson Cooke WA4RHT
3127 June Drive
Charlotte, N. C. 28205

A Poor Man's Transmitter Cabinet

Judging by the appearance of some ham shacks, proper packaging of the equipment presents a major problem to the roll-your-own amateur. Many transmitters sound wonderful on the air, but look like something the junior operator dragged in from the junk yard. These eyesores can be dangerous to the operator and to any visitors to the shack.

After putting up with poor packaging at my station for a time, I decided to act. This article describes how the problem was solved; the finished transmitter cabinet meets the following requirements:

1. Complete enclosure to keep children out of the wiring.
2. Adequate TVI shielding.
3. Pleasing appearance.
4. Adequate space for a complete medium power transmitter.
5. Construction possible with only simple tools.
6. Low cost.

Inside view of the TV cabinet showing the aluminum foil shielding and the Command Transmitter mounted on the front panel. Note that the foil extends over the back of the cabinet to the edge of the wood frame; this overlap provides generous metal to metal bonding when the rear shield is in place.

My transmitter cabinet provides 7.5 cubic feet of usable space for less than five dollars; with a little effort the average amateur can duplicate this in a modest workshop. The finished product will adequately house an AM transmitter of several hundred watts or a SSB transmitter running the legal limit.

The basis of this project is a used floor model TV cabinet. Many enterprising amateurs find a wealth of usable parts in old junked TV sets; why not use the cabinet too? There are many old TV sets around with large wooden cabinets available for the asking. A friend gave me the one I used. A plastic cabinet might be usable, but wood is easier to work with. A table model cabinet would be excellent for a small transmitter.

Here's how I converted my cabinet. I lined the cabinet with a heavy grade of aluminum foil on the inside top and sides and a piece of sheet aluminum on the bottom and front. The front panel must be heavy enough to support the weight of any attached equipment. A better job, though more expensive, could be done with lightweight sheet aluminum throughout. In any case, allow generous overlap and metal to metal bonding at the joints. A long crack lets out quite a bit of rf energy. I attached the foil with glue and staples.

The back of the cabinet has a door which is easily removed. In the cabinet shown in the photograph, copper window screen was stretched over a thin wood frame, but a sheet of thin aluminum sheet perforated with small holes would be better. In any case the material must preserve the shielding and permit free circulation of air; for high power transmitters, the use of a blower should be considered.

The best shielding in the world will not

prevent TVI if the leads leaving the shielded enclosure are not filtered. A simple length of shielded hook-up wire bypassed at both ends *might* provide adequate filtering, but I used the more elaborate filter shown in Fig. 1. I built a metal box from an old tin can with tin ships, pliers, and a propane torch. Although not attractive, it cannot be seen when mounted in the cabinet.

The bypass capacitors might work better inside the box than out, but they perform well in this unit and were more easily mounted on the outside. I mounted them with very short leads close to the point where the coil lead passes through the box. Ceramic feed-through insulators should be used for circuits carrying high voltage.

The coils must be wound with wire adequate to carry the current. The only place where this might present a problem is in the heater leads. The coils were wound on a section of 5/16 inch rod; they are self supporting when used with very short leads. About one inch of close wound number 26 wire was used for all coils except the one carrying heater current; this coil was wound with number 18.

The bypass capacitors were disc ceramics salvaged from old TV receivers, except as a safety precaution I used new capacitors for the high voltage leads. The photograph shows the filter mounted in the cabinet with five leads rated at below 1000 volts. A high voltage filter will be mounted immediately in front of the present filter when the medium power final is completed.

I feel that I have met all six requirements set forth in the beginning of this article; the transmitter is completely enclosed and quite safe from contact with high voltage. At the present time this cabinet is pretty large for the command transmitter and its power supply, but there is room to expand; I am working on an 813 final for more power.

No trace of TVI is observed on any of the area television stations located 40 miles away. My own TV receiver has no high pass filter and is several years old. When the transmitter was operated outside the cabinet and without lead filtering I experienced severe TVI to both sound and picture.

Do not let the do-it-yourself urge be suppressed by the lack of a proper cabinet. Find an old TV cabinet and package that rig!

. . . WA4RHT

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Micro-logic for Non-logical Users

The title is not meant to imply that amateur operators are *illogical* in any way, but rather to identify this article as one in which integrated circuit (IC) logic elements are used in ways for which they weren't specifically designed. That is, it will attempt to show some of the many ways that amateurs can use digital IC's in circuits that are non-computer oriented.

Historically, there are two reasons why the digital IC (micro-logic) became readily available at low cost before the linear IC. One of these reasons was the rapid growth of the digital computer industry; increasing both individual computer size and the number of computers in production. Size, cost, and reliability requirements of the new digital computers offered a rich prize to the semiconductor industry if it could come up with an IC to suit computers. The second reason digital IC's came first is the fact that logic circuits are easier to make than linear circuits. Logic circuits generally require only that their transistors be in one state or another (for instance, "on" or "off") and this requirement is relatively easily met by mass production units.

Out of all the research that was poured into the realization of the digital IC for the computer industry, several "logic families" of IC's emerged. These logic families have all made successes in computer use to one extent or another and no *one* family has yet obtained a clearcut advantage over the others on all counts.[1,2] The present major logic families are: Resistor Transistor Logic (RTL), Diode Transistor Logic (DTL) Transistor-Transistor Logic (TTL), and Emitter Coupled Logic (ECL).

RTL Integrated Circuits have become the

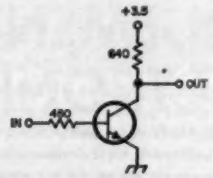


Fig. 1. The basic transistor gate.

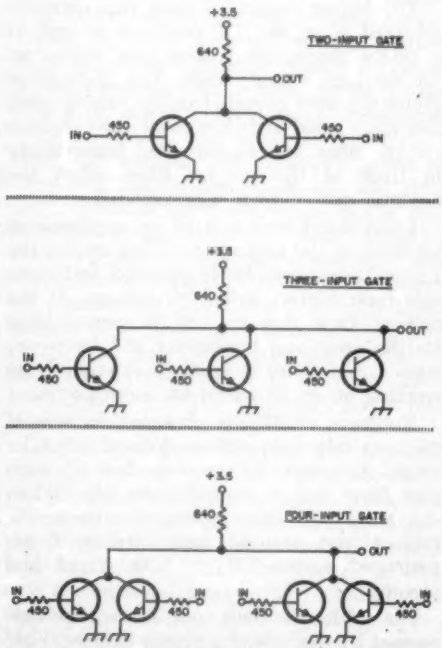


Fig. 2. Various gate arrangements—two input, three input and four input.

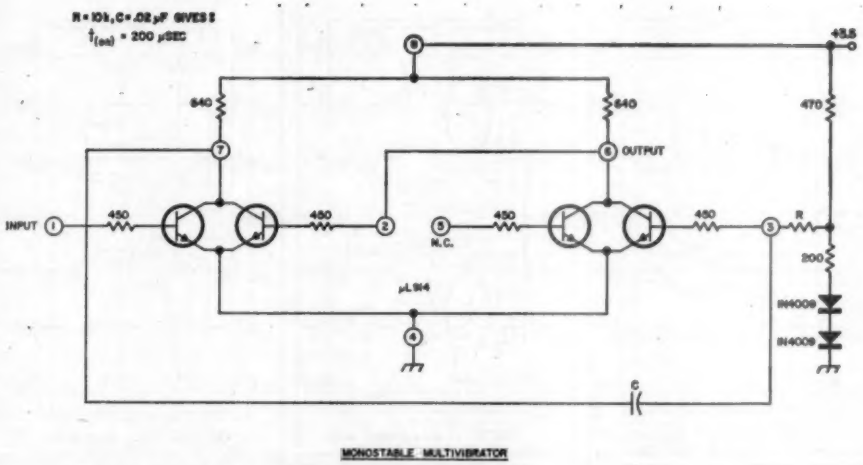


Fig. 4. A monostable multivibrator using the μL914.

least expensive, most available IC's on the market. In small quantities (1-99) the price of a simple J-K flip-flop has dropped to $1.35 and that of a dual two-input gate to $.80. A number of semi-conductor manufacturers, Motorola, Fairchild, Sperry, Texas Instruments, and others all make the RTL line; and at least between *some* units, voltages are compatible. There are two mainly-used packages, the TO-5 can with 8 or 10 pins and the "Dual-Inline Package" (DIP) with 14 pins.

The basic building block of the RTL family is the gate shown in **Fig. 1.** This gate can be expanded into two, three, and four-input types as shown in **Fig. 2.** In the gates shown in **Fig. 1** and **2,** a + 1 volt input to *any* input will saturate a transistor and pull the output *down* from the +3.5V supply level to saturation.

One of the least expensive and most ver-

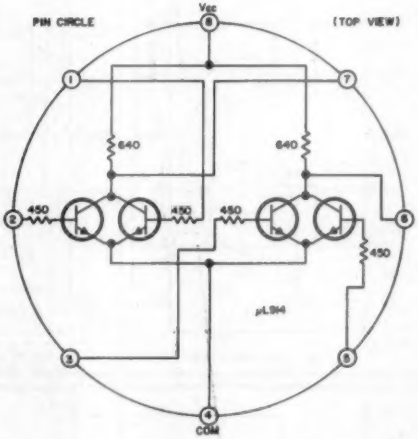
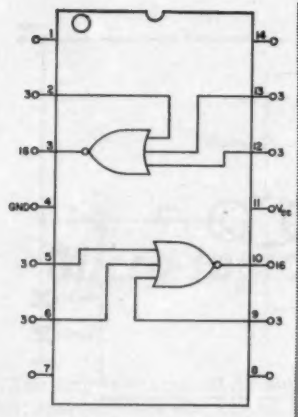


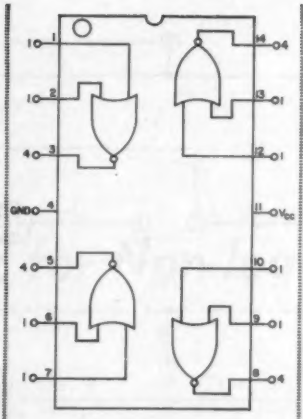
Fig. 3. Basing diagram and circuit of the Fairchild μL914 RTL gate.

HEP Number	MC-Number	Description	Amateur Use (other than logic)
553	303	Half-adder	
554	304	Bias-driver	Regulator
556	306	Three-input gate	Schmitt trigger, free-running multivibrator, amplifier
558	308	J-K flip-flop	Divider, one-shot multivibrator

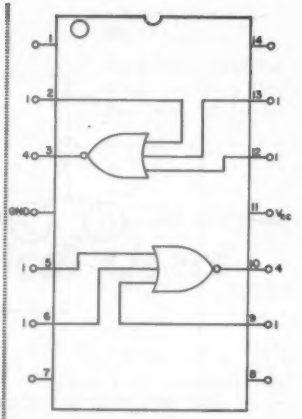
Table 2. Comparison of the Motorola HEP line totheir MC300 IC elements.



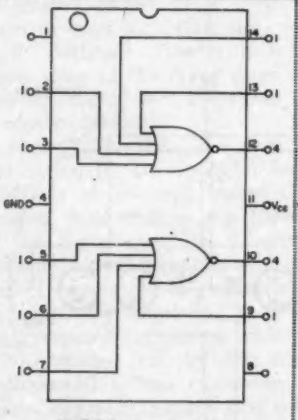
MC715P DUAL 3-INPUT GATE



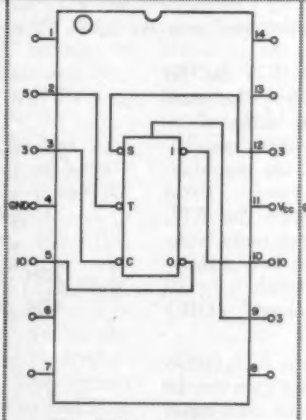
MC717P QUAD 2-INPUT GATE



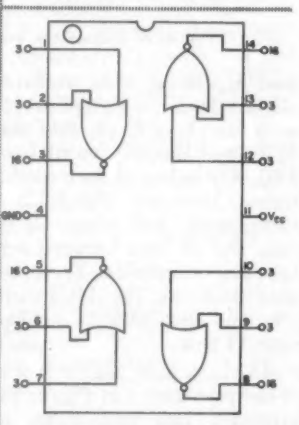
MC718P DUAL 3-INPUT GATE



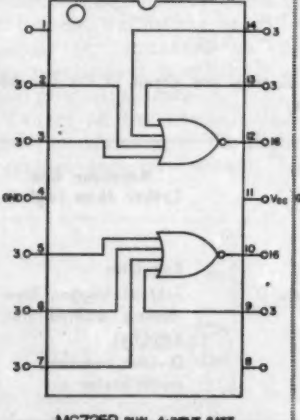
MC719P DUAL 4-INPUT GATE



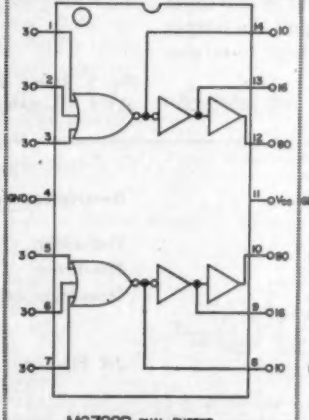
MC723P J-K FLIP-FLOP



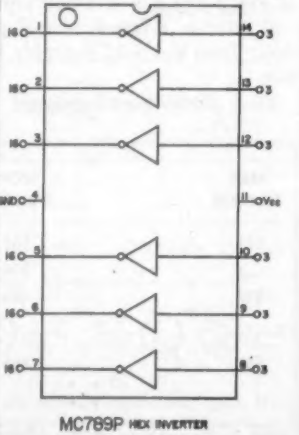
MC724P QUAD 2-INPUT GATE



MC725P DUAL 4-INPUT GATE



MC788P DUAL BUFFER



MC789P HEX INVERTER

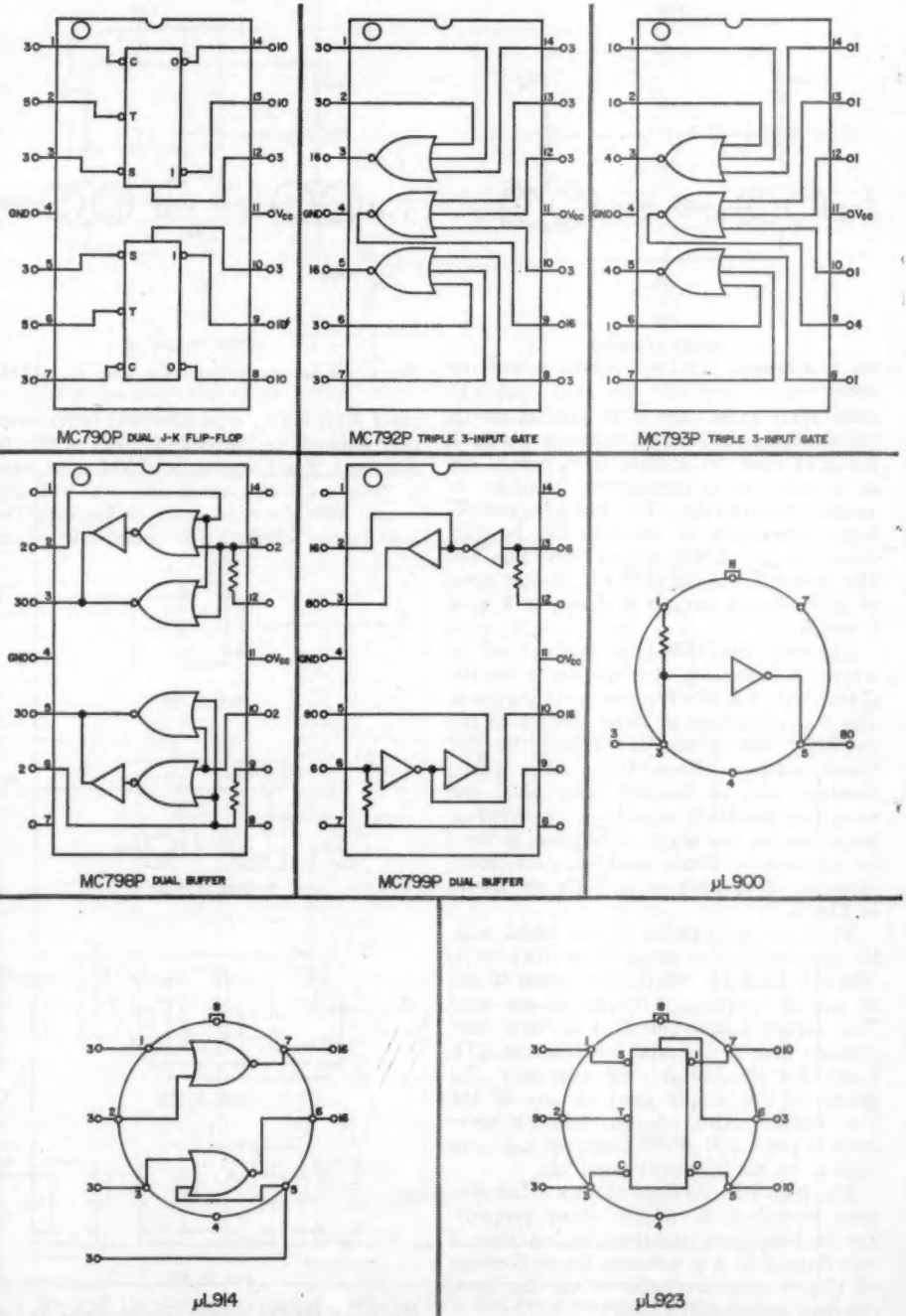


Table 1. Basing diagrams, circuit logic and load factors for popular IC packages. The MC-numbered units are manufactured by Motorola; μL-units by Fairchild.

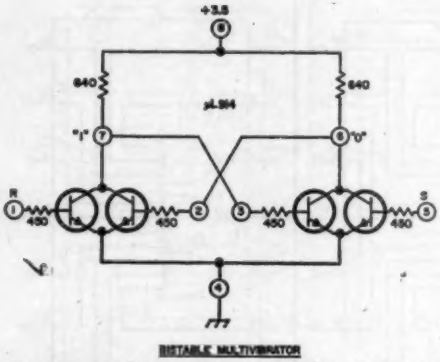


Fig. 5. A Fairchild μL914 in a bistable multivibrator circuit.

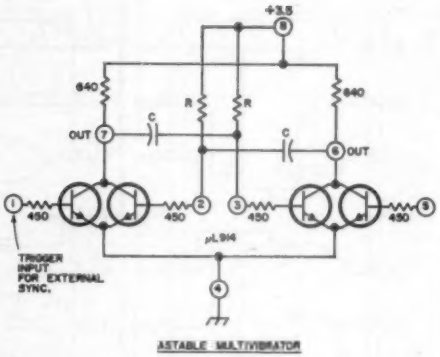


Fig. 6. An astable multivibrator using the μL914.

satile RTL gates that is in general use is the Fairchild μL914. This is shown in Fig. 3, It can be used (in addition to its normal use as a gate) as a monostable, bistable, or astable multivibrator. The bistable multivibrator connection of this chip can be purchased as the μL902, a type "RS" flip-flop. The connection of the μL914 in various types of multivibrator circuits is shown in Fig. 4, 5 and 6.

Although the μL914 is easily used as a type "RS" flip-flop, it is simpler to use the μL923 type J-K flip-flop for most purposes. The real advantage of using the J-K is the simplicity one attains in dividing by different numbers. Even fairly large prime numbers may be divided using J-K's, and no critical feedback capacitors are required. Since the J-K has many ports, there a number of ways to divide most numbers. Some examples of dividers using J-K's are shown in Fig. 7.

There are some points of care which must be observed when using these RTL IC's. The individual J-K will draw between 20 and 25 mA of current at 3.6 volts, so use good "fat" supply leads. This care in buss (and ground) lines is essential, because the RTL family has the lowest noise immunity (for spikes on the supply line) of any of the logic families. Also, when in doubt, it never hurts to put a 330 μF-6V tantalytic capacitor right across the IC supply terminals.

The RTL J-K flip-flops require a fast rise-time waveform to trigger them properly. Try to keep your rise-time to less than 1 μsec if possible. For instance, the ÷ 5 circuit of Fig. 7 was unreliable when the input rise-time approached 3 μsec.

The convention in the Motorola and Fairchild RTL family is to add load factor numbers adjacent to the pin numbers of the IC diagrams. For instance, a μL914 gate input is *three* units of loading and a μL914 gate output will drive *16* units of loading. This load factor scheduling is completely consis-

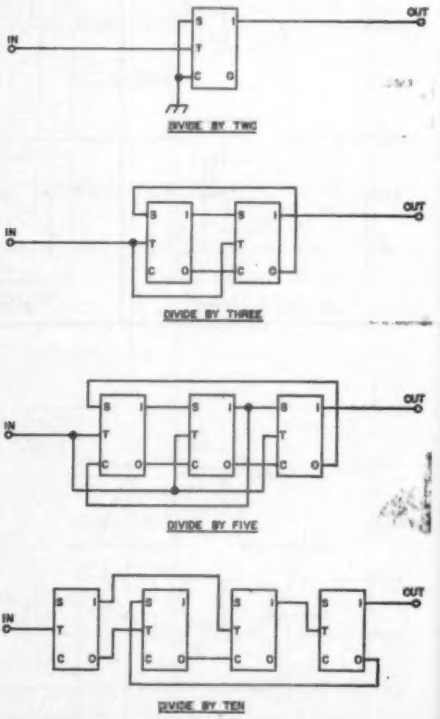


Fig. 7. J-K flip-flop divider circuits; divide by two, three, five and ten.

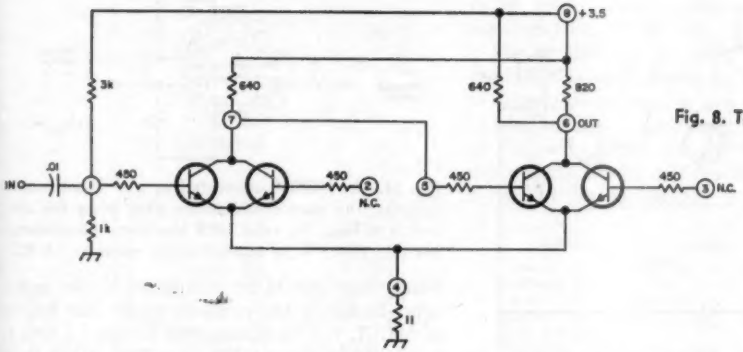


Fig. 8. The Schmitt trigger.

tent within the Fairchild μL900 series, even though some members of this family are lower power units than others. The Motorola MC-700P series uses the same supply voltages and logic voltage levels; and the load factor designations are also compatible with

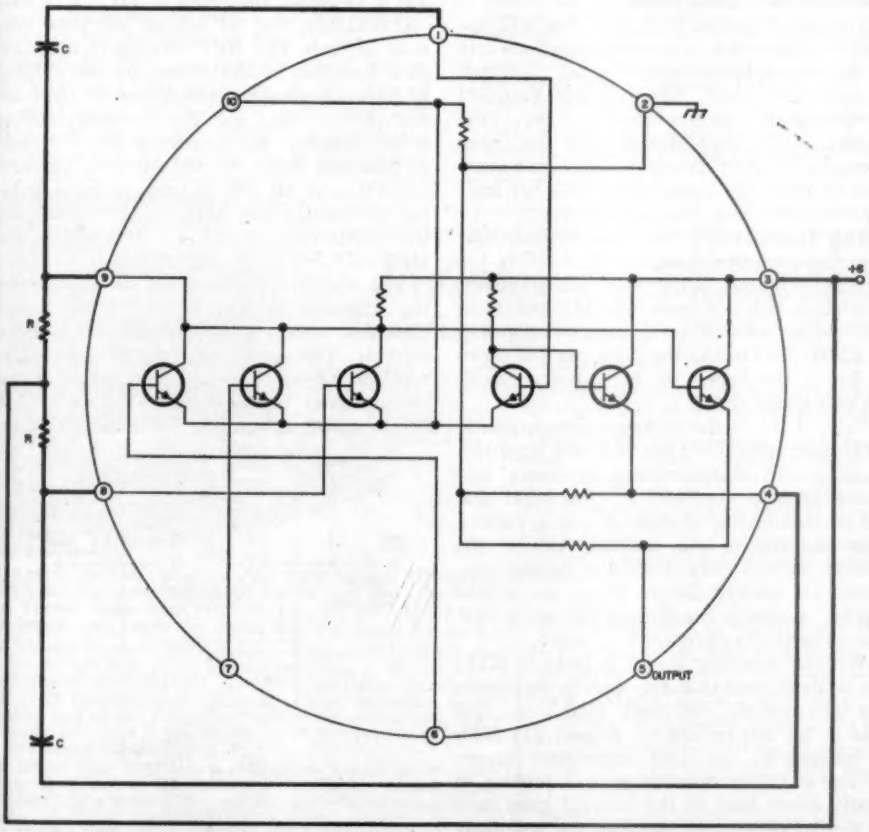


Fig. 9. The HEP 556 connected as a free-running multivibrator. For an output frequency of 1200 Hz, R = 100k and C = 0.01 uF. For greater output level at the expense of waveform distortion, pins number 2 and 10 may be shorted together.

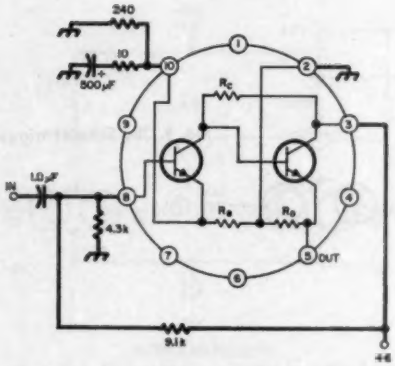


Fig. 10. Using the HEP556 as a low input impedance, low-level amplifier. The voltage gain of this circuit is approximately 20.

the Fairchild μL900 family.

The only types of RTL IC's that will appeal to those with low budget projects will be the less-expensive units that are packaged in epoxy or plastic. Three of the Fairchild μL900 family are available in epoxy: the μL900, μL914, and μL923. Also the entire Motorola MC700P family is plastic and available at about the same price level *per logic function* as the Fairchild μL900 series.

The Motorola MC700P line includes only one single function unit, the MC723P—a J-K flip-flop. The rest of this DIP family consists of multiple function units. The MC790P is an outstanding one; it is a dual J-K flip-flop at $2.00. This brings the price per J-K down to $1.00, the lowest in the industry to this author's knowledge.

Table 1 shows the various economy-plastic RTL units available from the two lines discussed, with their loading diagrams and prices. It is important to keep in mind that the pin-numbering of *these* IC's is *as viewed from the top of the package;* this is the reverse of the way transistor basing diagrams are usually shown. There are several articles available on these RTL units that can be helpful: references 3, 4, and 5.

Without sounding biased in favor of RTL, the author feels that this family represents the best one to "cut one's teeth" on. The reasons for this feeling are simple: (1) RTL is inexpensive, so first experience comes cheap, and (2) since there is a resistor in nearly every lead to the internal transistors of the IC chip, your mistakes are not likely to destroy the units.

ECL (Emitter-Coupled Logic) is another

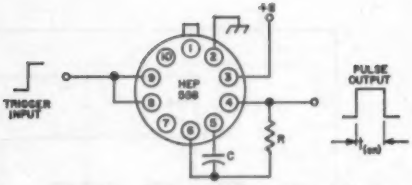


Fig. 11. The HEP558 connected as a one-shot multivibrator. The main consideration when using this circuit is to keep the value of R less than 160 kilohms; the $t_{(on)}$ time will be approximately equal to 1.4 RC.

family that should be of interest to the amateur. Motorola has recently made four types of MECL (Motorola Emitter Coupled Logic) available in their HEP line. This HEP line has the distinct advantage of being available nearly anywhere in the U.S. and also through mail order firms such as Allied Electronics. Table II shows the types of HEP IC's that are available, and the similar industrial versions of each. The HEP versions of the standard Motorola MC300 series are not obliged to have the same specifications as their industrial versions, but the cross-referencing is still helpful. By consulting the Motorola Application Notes for the MC303, MC304, MC306, and MC308, a large body of helpful information can be gleaned on uses for the HEP553, HEP554, HEP556, and HEP558.[6, 7, 8]

The MECL family is unlike most other logic families in that a logic level change does not cause any component transistors to saturate. This means that the MECL family can operate much faster than others, since no saturated transistors have to be pulled out of saturation during switching. The in-

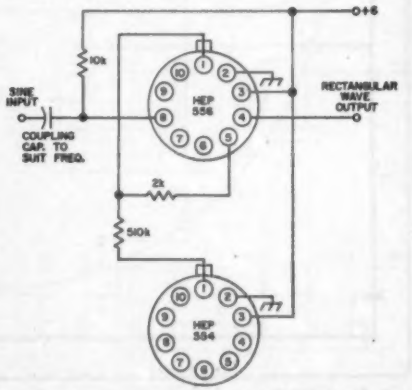


Fig. 12. Using the HEP554 and HEP556 as a Schmitt trigger. The 510k resistor should be 510 ohms.

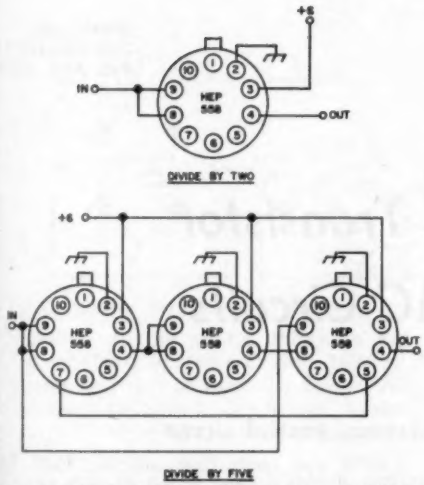


Fig. 13. Connecting the HEP558 IC as a divider—divide by two and divide by five.

dustrial MC300 units can be used up to 30 MHz switching rates, so, we can expect to find *some* of the HEP units that will approach this rate, too. This inherently faster operation is reflected in small propagation time through counting elements. This allows us to build serial dividers of *large* prime numbers, like 17, at fairly high frequencies.[9]

Fig. 9 through 13 show several uses for the HEP integrated circuits. The applications to which these circuits are put, will be left to the readers' needs and ingenuity. Some of the units which can be built using HEP integrated circuits are described in detail in a booklet by Motorola.[10]

. . . W6GXN

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Proportional Transistor Control of AC Circuits

Proportional dc control of ac circuits has been one of the sticky problems in electronics since the days of the slop-jar rectifier and the "Edison" storage B battery. Most of the successful circuits take the form of a good amplifier, in which the gain in varied by the dc control voltage. Until recently, this was an effective, but highly uneconomical, control method, and was usually limited to low powers.

Since the end of WW II, the situation has been improved by magnetic amplifiers, thyristors, and "back-to-back" configurations of transistors. All of these systems work, and some work very well, but their cost and bulk, not to mention procurement difficulties and delays, usually confine them to large-scale industrial and governmental use.

Relatively recent commercial availability of high-voltage transistors and of silicon bridge rectifiers of high current capacity has simplified high power rectification and control greatly, and has reduced prices enormously. A bit of cogitation, followed by some experiments, indicates that proportional control of any ac circuit by a small dc control voltage, using only rectifiers and transistors, in a simple configuration, is entirely possible.

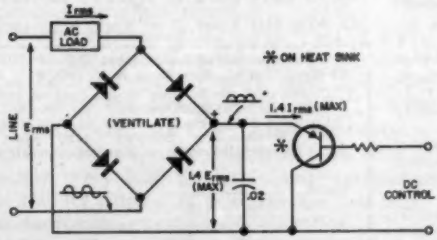

Fig. 1. General control circuit.

General control circuit

Circuit for controlling any ac load by means of a dc control voltage, using only a bridge rectifier and a transistor, is shown in schematic form in Fig. 1, with approximate voltage and current values.

In this circuit, everything to the left of the bridge is ac, from the line or other source. Everything to the right of the bridge is pulsating dc, resulting from the full wave rectification of the line power. With the bridge output shorted, current through the ac load is determined by the line voltage and the load reactance (less the very small losses in the bridge). With the bridge output open, voltage across the bridge output is approximately 1.414 times the line RMS voltage.

If a variable resistor is connected across the bridge output, the current through the load can be varied by varying the resistor. If the resistor is replaced by a suitable transistor (note voltage and current relations in Fig. 1), current in the ac load can be varied by varying the dc bias on the transistor. This current is at maximum when the transistor is saturated, at minimum when the transistor is cut off, and at various intermediate values determined by base bias when the transistor is between saturation and cutoff. With a single control transistor, controlled power is from 30 to 50 times controlling power. With a Darlington pair in the control position, control ratios of considerably better than 1,000 to 1 are easily obtained.

Specific circuit data

Using standard and easily-obtained parts, a specific circuit, much like the general circuit of Fig. 1, was constructed and tested.

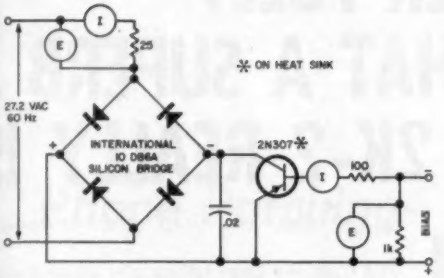

Fig. 2. Specific test circuit, with constants.

Results with this circuit, shown in **Fig. 2**, are tabulated in **Table I.** Note that in this circuit, polarity of both the bridge and of the transistor have been reversed, so that, in event of failure of the bias source, the load is deenergized.

As will be noted from **Table I**, performance of the circuit is smooth, there being no serious "boobles" in the control characteristic. It is quite important that the transistor have an adequate heat sink, or its characteristics will change with use—usually not for the better. A 4" x 4" by 1/16" sheet of copper, exposed to free air circulation, was found adequate for the 2N307 here used. The small capacitor shunted across the bridge is a hash filter. Its value depends in part upon the characteristics of the load, and may be anything from .01 to .1 μF per ampere of current without impairing circuit operation.

Extension to higher power

The test circuit shown in **Fig. 2** has a power handling capability of 25 volt-amperes. Theoretically, the same circuit can be used for any power by suitable choice of bridge rectifier and transistor. In practice, we are now limited to about 400 volt-amperes because of the limitations of available transistors, the upper limit being attainable with the Delco DTS 423 transistors. By using an elevated line voltage, (above 115), we can squeeze out some more volt-amperes. Watch out for polarity when changing transistor types.

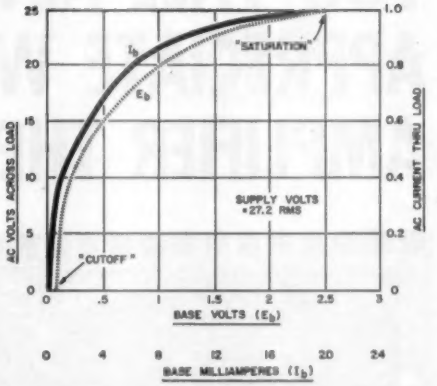

Table I. Performance of the circuit shown in Fig. 2.

When the new 10 and 20 ampere high-voltage transistors, now reportedly being developed by at least three manufacturers, appear on the market, we will be able to control more than 2,000 volt-amperes of ac by means of a relatively small dc control power.

Applications

This control circuit is an excellent replacement for a Variac within the presently-existing power limitations. As the control power is low voltage low current dv, the main elements (rectifier and transistor) can be placed near the load, and the control element, such as an Ohmite AB pot, mounted at any convenient place on the panel.

This circuit permits convenient primary control of power supplies, either manual or automatic, and has a number of possible protective applications, such as shutting off plate power when bias voltage fails.

Life of components, when properly cooled, is problematical, but very long. Silicon bridge rectifiers have service lives measurable in years (5 or more); and modern power transistors, either germanium or silicon, seem to be equally dependable. ■

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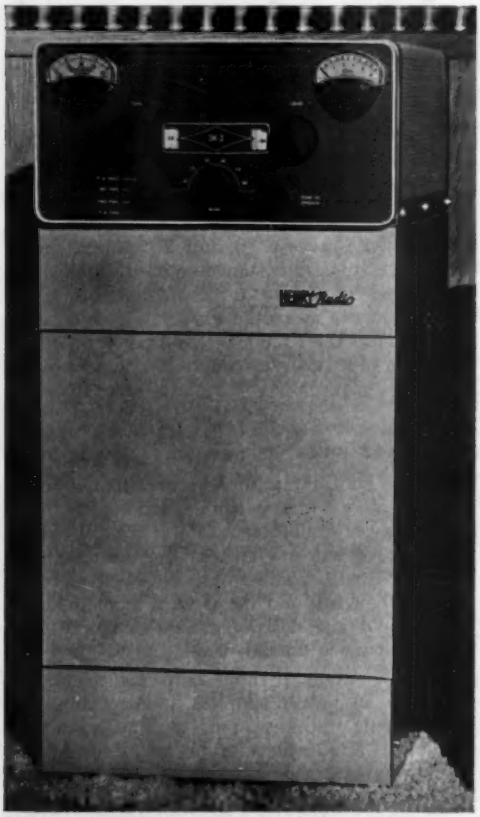

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Litigation presently in the courts may clear up the legalities of phone patches.

More than seven years ago, an eloquent plea for legalizing amateur radio phone patches was made by Mr. C. D. Ehinger, a ham, K9IVY, and also a prominent member of the telephone industry, in an article which appeared in the December, 1959 issue of *Electronics World*. The article was symptomatic of the controversy that has surrounded the "gray area" of amateur radio phone patching for years and which, at last, appears headed for legal resolution.

A phone patch is, in essence, a device which interconnects the facilities of the telephone company with a two-way radio system. Tariffs filed with the Federal Communications Commission by AT&T and other telephone companies prohibit such interconnections unless the equipment, with a few exceptions, is provided by the telephone company. From the telephone company viewpoint, this restriction is necessary to prevent possible interference to telephone service resulting from the direct or indirect connection of a "foreign attachment" to a telephone line. This viewpoint is defended on the basis of the responsibility of the telephone company to provide dependable land-line communications under federal regulation in return for being granted a monopoly for telephone service in a certain area.

Over a year ago, the Carter Electronics Corp., of Dallas, a manufacturer of a phone patch device called *Carterfone*, filed an anti-trust suit against AT&T, Southwestern Bell, and General Telephone Company of the Southwest. Carter Electronics seeks compensation for damages resulting from an alleged loss of business due to threats by the defendant telephone companies to discontinue service to individuals and firms using the *Carterfone*. The courts, before handing down a decision in the *Carterfone* case, have asked the FCC to resolve the question of the "justness, reasonableness, validity, and effect" of the current tariff regulation. Thus, the FCC, which has in the past indicated that phone patches do not violate FCC radio service rules but has avoided the issue of the validity of the telephone company tariffs, must now come to grips with the problem. A hearing before an FCC examiner is scheduled within the next few months.

The arguments in favor of legalizing phone patches are reasonable and persuasive. From the predominant commercial viewpoint, properly designed and effective phone patches can be produced at prices well below the usually prohibitive cost of telephone company equipment offered to provide a similar service. The installation of such phone patches result in more efficient and increased use of telephone facilities. In the non-commercial area of amateur radio, if phone patches were

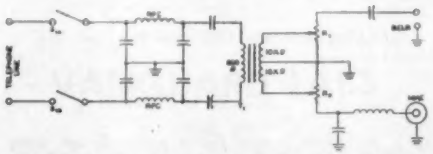

Fig. 1. Typical "home-brewed" phone patch which was widely used with AM transmitters.

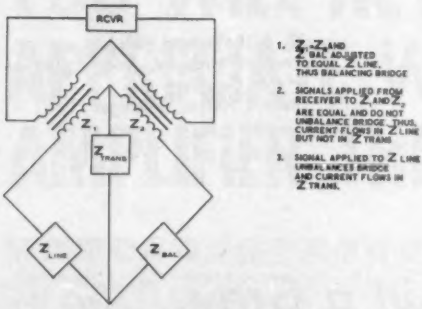
RCVR
1. Z_1-Z_2 AND Z_{BAL} ADJUSTED TO EQUAL Z_{LINE}, THUS BALANCING BRIDGE
2. SIGNALS APPLIED FROM RECEIVER TO Z_1 AND Z_2 ARE EQUAL AND DO NOT UNBALANCE BRIDGE. THUS, CURRENT FLOWS IN Z_{LINE} BUT NOT IN Z_{TRANS}
3. SIGNAL APPLIED TO Z_{LINE} UNBALANCES BRIDGE AND CURRENT FLOWS IN Z_{TRANS}.
Z_1
Z_2
Z_{TRANS}
Z_{LINE}
Z_{BAL}

Fig. 2. The Wheatstone bridge is the basis for modern hybrid phone patch circuits employed with VOX operated SSB transmitters.

to be removed from the "gray area", a marked increase in public service phone-patch traffic, particularly with overseas military personnel, would ensue. Telephone companies have in the past indirectly indicated the usefulness of the phone patch by turning their heads the other way concerning amateur radio use of these devices. Nevertheless, the "gray market" has forced all but two amateur radio equipment manufacturers, Heath Company and Waters Manufacturing Company, out of the ham phone patch business. Heath Company reports that despite the "gray area" and to the best of their knowledge, their patch has never been the cause for a complaint by a telephone company against a user. Adequate performance and low-cost therefore appear to be compatible in today's phone patch designs.

Adequate performance was not always the case with amateur radio phone patches. The type of patch illustrated schematically in **Fig. 1** was considered fairly sophisticated fifteen years ago but provided what could be termed only satisfactory performance with AM rigs at that time. This design employed

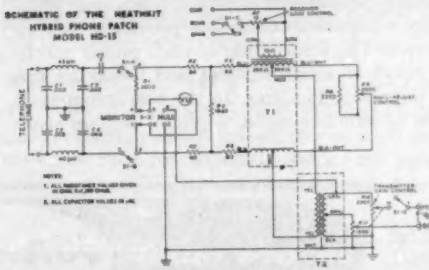

Fig. 3. A typical hybrid phone patch design using special transformers for optimum energy transfer and impedance matching.

an audio output-to-line transformer which at least approximated a match to the telephone line impedance. The center-tapped high impedance winding helped reduce hum pickup which was a real problem in early home-brew patches. Most of us can also recall phone patch circuits which employed power transformers in crude designs which were matched by equally crude performance. One can only imagine the detrimental effect these devices had on telephone service. The circuit in **Fig. 1** was, with its attention to impedance matching, hum reduction, and rf filtering and bypassing, at least a step in the right direction.

With the increased popularity of SSB by the early sixties, phone patch design was forced to take a giant step forward to satisfy the demand for patch operation consistent with the VOX capability found on most all SSB transmitters. To eliminate the need for manual transit-receive switching during phone patch operation with VOX equipped SSB rigs, true telephone-type hybrid circuitry was required in patch designs. Thus, more accurate telephone line impedance matching was a necessity and telephone quality transformers were employed. Also about this time, the need for monitoring the input level to the telephone line was realized and VU meters, as employed by the telephone industry, became standard equipment on most hybrid phone patches.

The operation of a hybrid phone patch can best be understood by referring to **Fig. 2.** The basic requirement of the circuit is to passively couple audio from the receiver into the telephone line without energy being delivered to the transmitter audio input at a level which will cause the VOX circuit to operate. As described in **Fig. 2,** our old friend, the Wheatstone bridge, provides an effective means of satisfying the basic patch requirement outlined above.

A practical embodiment of this circuit is illustrated in the hybrid phone patch design presented in **Fig. 3.** In addition to the normal hybrid circuit components, on-off switching functions and appropriate rf filtering, several other significant circuit techniques are evident here. A 600 ohm resistive H pad is provided to isolate the telephone line impedance, which can vary from installation to installation, so that a simple balance network can provide maximum transmit-receive isolation at every installation. The VU meter can be switched from its normal line level

Fig. 4. The Heath HD-15 Hybrid Phone Patch employs a VU meter for monitoring input level to the telephone line and indicating correct null adjustment.

monitoring function to a null indicating function to permit accurate adjustment of the balance, or null, control. A strong heterodyne is tuned in on the receiver and, with the patch on and a telephone call actually placed, the balance control is adjusted for a null on the VU meter which is measuring the voltage developed across the transmitter input level control. Once set, the balance control usually needs no further adjustment. Notice also that this patch design also employs transformers which match the impedance of the receiver output and transmitter input as well as those of the telephone line to provide maximum overall energy transfer.

Mr. Ehinger's 1959 article suggested several requirements for the design and use of legal phone patches. These were use only with radio equipment and by operators having valid FCC licenses, use only on a private telephone line, location of the telephone at the radio operating position, patch provision for monitoring input level to the telephone line, and payment of a nominal, monthly fee to the telephone company. All requirements, except the last, still seem to be reasonable. If the tariff is revised to permit phone patching, it does not appear that the telephone companies would be justified in charging a fee for use of equipment that belongs to an individual. Phone patches supplied by the telephone company, should they be made available, would be a different matter.

Whatever the outcome of the *Carterfone* litigation, it is encouraging that the question of phone patch legality is finally being scrutinized. At least it indicates that there is a growing interest in legalizing phone patches and that a demand exists for reasonably priced phone patch equipment. Let's hope a decision favorable to hams will be handed down and result in complete illumination of the "gray area". . . . K8BLL

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WTW Report

WTW is picking up faster all the time now. If the requests for our new WTW country list/tally sheets are any indication, things will be rolling in high gear for sure in a few months from now. I have been sending out these sheets at the rate of six a day. It seems as if many fellows are interested in WTW—a lot more than I ever thought.

The new WTW country list/tally sheets consist of four pages printed on both sides. Spaces have been allowed so that you can use them for ten years. About every fifth line has been left blank for additions as they turn up or corrections as they are discovered. I will take full blame for the various mistakes that are on these sheets—they were laid out, made up and printed by me so these mistakes cannot be blamed on anyone other than myself. They are free for the asking provided you send along a manila envelope (9 by 14 inches or larger) self addressed and with 10c worth of stamps on it. This will pay the postage for 3 or 4 sets of these forms depending upon the weight of the envelope. One set of these forms must be filled out and sent in with your first batch of cards. We retain this form and file it away to add the countries as you send them in to us. One form is required for each mode on each band. This may seem like a lot of work but later on it will simplify our task of keeping the records straight. This will be especially true when the 5 year period has passed and you begin to lose the countries you worked 5 years ago.

If you are considering trying for WTW, by all means get yourself a set of these forms. It will make your record keeping a lot easier I am sure. A complete list of WTW countries is included so you know what counts and what doesn't. A few of them may surprise you if you have not seen our list recently. Send along a large envelope for your copies and it will be sent out pronto.

We have received many suggestions from different DXers regarding WTW. At this moment we have not decided what changes, if any, will take place. Right now we are "mulling over" the idea of accepting cards in multiples of less than 100. This would keep everyone informed as to how others are doing in their WTW work.

There will be a column in each issue of 73 from now on that's devoted to the progress of WTW. We think it will be of interest to all DXers because competition will become keener as more fellows qualify. The day may come when we will keep a running record of the top 10 or 20 or even 30 who are battling it out for top position. I have had many letters suggesting this and it seems that this would make things more interesting to the fellows. What do you think Mr. DXer?

At this time we still need a DX Club to check WSL cards for these call areas: W/K 1, W/K 2, W/K 5, W/K 8, and W/K Ø. We need one or two such check points for Africa, one in the southern part and one in the north. Two are still needed in Asia too—one around Hong Kong or Japan and the other somewhere around western India, Tehran or thereabouts.

Do we have any volunteers for these check points? We furnish the necessary blanks needed for proper record-keeping. We want every checkpoint to use the same kind of record keeping so that we will have a uniform system. The work involved is not too great, at least not at this time, but we hope it will grow as WTW interest grows.

The address of each of the current WTW QSL check points is as follows:

W/K 3—Western Pennsylvania DX Society, John F. Wojkiewicz W3GJY, 1400 Chaplin Street, Conway, Pennsylvania 15027.

W/K 4—The Virginia Century Club, P.O. Box 5565, Virginia Beach, Virginia 23455.

W/K 6—Orange County DX Club, James N. Chavarria, 3311 Stearns Drive, Orange, California 92666.

W/K 7—Western Washington DX Club, Inc., William H. Bennitt W7PHO, 18549 Normandy, Seattle, Washington 98166.

W/K 9—The Montgomery County Amateur Radio Club, Scott Millick K9PPX, Litchfield, Illinois 62056.

Canada—The Edmonton DX Club (VE6GX), 12907 136th Avenue, Edmonton, Alberta, Canada.

Oceania—The New Zealand Association of Radio Transmitters, Jock White ZL2GX, Contest and Awards Manager, 152 Lytton Road, Gisborne, New Zealand.

South America—Venezuela Amateur Radio Club, P. O. Box 2285, Attention of YV5CHO DX Committee, Caracas, Venezuela, South America.

Europe—Via R.S.G.B.

Hawaiian amateurs send their cards to the W6 check point.

All others send your cards to: Gus M. Browning, Route 1, Box 161-A, Cordova, South Carolina 29039.

Each group of cards sent to any check point must be accompanied with a remittance of $1.00 to cover costs of certificates and handling—*plus* postage to cover the return of your cards. Please specify method of shipment and enclose a large addressed envelope. Otherwise your cards will be returned to you via third class mail.

Notice that W5KUC, W4NJF and W3DJZ have qualified for the 200 country certificate for 14 MHz phone. Mind you, these fellows have worked and received QSL cards from 200 countries in less than one year. As you know, WTW only started at 0001 GMT May 1st last year. This should prove to you that it's possible if you make up your mind that you are going all out. I bet these fellows had a ball working DX all over again. I know these fellows and they are the type who get things done when they make up their mind to do it. We wish to congratulate them on a job well done. They are presently working hard on their WTW-300—WOW—I sure hope they make it. That's it for this month. If you have any questions please write me and I will try to answer. Please send along a sase. Thanks.

. . . *Gus*

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What's New for You?

This column is set aside for short technical notes, comments on 73 articles, information about new and useful components and surplus, and announcements about technical nets and technical clubs. If you've come across something that you think would interest 73 readers, but don't think it's worth a full article, send it along. We'll give you credit in the column. Send your contributions to Paul Franson, 38 Heritage Road, Acton, Massachusetts 01720.

Don't forget that we're looking for a new name for the column, a name that fits the content a bit better than the present one. I've heard two suggestions so far, but I'm not sure whether they're serious: Technical Trash, and Electronic Eclecticism.

New FET's

There are several new field effect transistors on the market which should appeal to the amateur experimenter. The most exciting of these is probably the 2N4416 from Union Carbide. This device is still somewhat expensive (about $6.00), but displays excellent noise characteristics on 144 and up. Preamplifiers built for 432 MHz with the 2N4416 for example, exhibit noise figures on the order of 2.5 dB: gain is 12 dB. On 144 the noise figure is about 2 dB with 18 dB gain. Next month 73 will have a construction article using this FET in both 144 and 432 preamplifiers.

A low cost plastic encapsulated FET which looks quite interesting is the new Motorola MPF-102. This transistor is designed for VHF amplifier and mixer applications and features guaranteed parameters at 100 MHz. Forward transconductance at 100 MHz is 1600 μmhos minimum. The input capacitance is 7 pF and the reverse transfer capacitance is 3 pF. Maximum drain-source voltage is 25 volts.

73 Transistor Circuits

Trouble with FET diagrams *again!* In W1DTY's article in the March issue there are several errors in the schematics using field effect transistors. The thing to remember here is that the N-channel FET requires a positive drain supply, the P-channel FET, a negative supply. P-channel FET's include the 2N2607, 2N4360, TIM12 and U112. N-channel types are the 2N2943, 2N3819, 2N3820, HEP-01, MPF-103, -104, -105 and TIS34.

Diagrams to watch in the circuits article are Fig. 11, 17, 39, 40, 47 and 71.

Transconductance Tester Troubles

WA4UZS reports that he had a little trouble with transients in the FET Transconductance Tester he built from W1DTY's article in the January 73, but cured it with a 0.047 μF capacitor across each of the push button switch contacts.

I-177B Schematic

A manual, schematic and updating information for the I-177B tube tester is available from the Engineering Department, Daven Division of the Thomas A. Edison Industries, Grenier Field, Manchester, N.H. 03103 for $2.50, reports W1DKG.

Slide Rule Error

The conversion of pi/2 radians in the article on slide rules in the March issue is wrong. It should be 90° instead of 1.57°. If you put 2 on the C scale over pi on the D scale, the answer is read on the D scale under R on the C scale. The basic formula for these conversions is pi × R =180, where R stands for 1 radian. Thanks to WA8LQS for this.

Product Detector Circuit Board

The connections on the right side of the circuit board on page 34 of the March 73 are reversed. The board is for a solid-state product detector. Gregory Perreault of Glen Rock, N.J. caught this one.

RTTY Translator Error

There is an error in the schematic of the RTTY encoder on page 37 of the January issue. The 0.033 and 0.038 μF capacitors in the frequency-determining network are reversed. The component reference numbers were also omitted from the schematics and pictorials, but not the text, causing some confusion. On page 35, R1 and R2 are the 6.8kΩ resistors in the emitters of Q2 and Q3. R12 on that page is the resistor shown in series with the magnet. On page 37, reference is made to an R10 and R12 in the encoder circuit. These two resistors are the 100 kΩ and 6.8Ω resistors attached to the base of Q4. The author of the article, W8AYZ, sent us these notes.

. . . Paul

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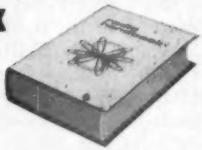

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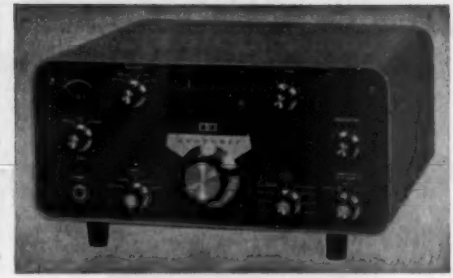

Mort Waters W2JDL
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Massapequa, L. I., N. Y.

The Heathkit SB301 Receiver

The Heathkit SB301 is an updated and improved version of the older SB300 which, in its short history has already earned a well-deserved niche in ham radio. The 301 is a ham-bands-only SSB/AM/CW/RTTY receiver with coverage from 3.5 MHz through 30 MHz, easily extendable to the 2- and 6-meter bands with accessory converters, both of which mount neatly on the receiver's rear apron. A front panel switch concentric with the rf gain control selects either converter and simultaneously switches the input of the receiver from the normal antenna to the converter outputs on 10 meters. Frequency coverage with the converter crystals supplied is from 144 to 146 MHz and 50 to 52 MHz—the tuning range can be increased with accessory crystals.

Power for the converters flows only to the converter which is selected by the panel switch mentioned before. When the receiver is operated on the low bands, no voltages reach the converters.

CIRCUITRY

The incoming signal is amplified by a 6BZ6, the rf stage and capacitance coupled to the grid of the first mixer, a 6AU6, which receives the local oscillator signal from the crystal-controlled 6AB4 heterodyne oscillator. The latter's coils have a small pickup winding which feeds the oscillator output to a jack on the rear apron, where it is available for transceiving with the matching transmitter, the SB401.

The 6AU6 mixer stage mixes the signals, with the sum and difference frequencies being applied to a bandpass coupler having a passband from 8.359 to 8.895 MHz. Emerging from the coupler, the wanted signal is then applied to the grid of the second mixer, another 6AU6. At the same time, the 5.0 to 5.5 MHz output of the LMO is coupled to its cathode. For transceiving, the LMO output is also fed to a jack, through a .01 capacitor.

The second mixer's output at the *if* frequency of 3.395 MHz passes through a crystal filter to the *if* stages (you get one filter with 2.1 kHz bandwidth with the kit; AM and CW filters are available as extra cost accessories).

The *if* amplifiers, 6BA6's are both high gain voltage amplifiers, tuned for maximum gain. The S-meter is connected between the screen of the first *if* and the cathode of the second, with a chassis-mounted zero-adjust potentiometer providing precise settings.

A new feature of the SB301 that didn't appear in the 300 is a self-biasing, full-wave, shunt-type noise limiter which automatically adjusts itself to the degree of modulation of the incoming signal. This system has the advantage of moving the point where limiting begins up and down along with the signal level. The limiter is either in or out of the circuit, depending on a push-pull switch integral with the AF gain control. The degree of limiting cannot be controlled manually. The system operates in all modes and performs effectively.

AGC voltage is obtained by rectifying a portion of the *if* output signal, then passing it through a capacitor-resistor network which applies the voltage to bias the rf amplifier and the *if* amplifiers. This system is of the instantaneous attack type; one of two decay "speeds" is switch selected—slow for SSB, fast for CW and AM. An "off" position is also provided for maximum gain when digging for the weak ones.

A three-section Compactron, a 6AS11, combines the product detector, BFO, and BFO amplifier in one envelope. The BFO oscillates at one of three crystal-controlled frequencies, selected by the mode switch. In the RTTY position, the crystal frequency is 3392.110 kHz, placing the detected signals of 2125 and 2975 kHz in the center of the band pass frequency range of the SSB crystal filter. Narrow band RTTY operation can be had in the CW position of the mode switch. If you're operating SSB and want to change sidebands, here's what happens: the crystal that is switched into the circuit increases the BFO's operating frequency by 2.8 kHz. At the same time, the LMO is automatically shifted 2.8 kHz lower by a diode switch so you've changed sidebands without having to move the dial—you continue to read frequency right off it.

The mixed *if* and BFO frequencies obtained from the product detector are capacitor-coupled to the grid of the first audio stage, one-half of a 6HF8, which drives the second audio; either high impedance headphones or 8-ohm speaker operation is available. Negative feedback from the output transformer to the cathode of the first audio stage provides low distortion audio.

For AM reception, the BFO is switched off and the *if* output is coupled to a diode detector instead of the product detector and thence to the audio stages.

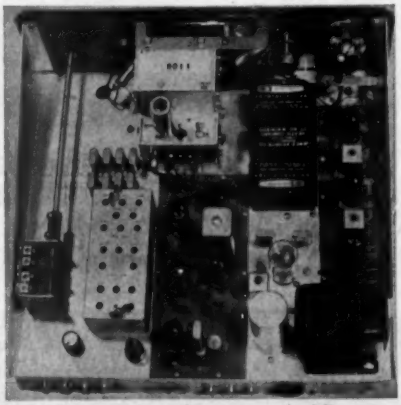
The lineup is completed by a 100 kHz calibrator that can be zeroed against WWV's 15 MHz signal. The band switch has a special position for receiving WWV—another new and welcome feature that was missing from the 300.

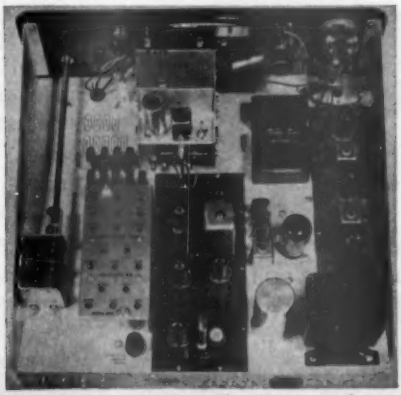
Assembly

No unusual problems were encountered in building the receiver except one of my own making. I did not observe the cardinal rule of kit building—read the instructions first, and follow them exactly. In blind confidence, I unpacked all the parts and sorted them out, but when I began to check them off against the parts list, I discovered that Heath had made another important advance. There were separate numbered "parts packages" that were called for individually as you begin each stage of assembly. The advantage is, of course, that you don't have a lot of small parts floating around long before you need them. Had I read the manual carefully I would have known this. Take warning, do as I say, and not as I do!

Total assembly time was about 24 hours, and alignment with the built-in crystal calibrator and S-meter went very rapidly. Not a single operating difficulty was found, a testimony to the good design, careful engineering and superb manual that makes it possible for anyone who can solder to build this kit successfully.

In case of difficulty, extensive trouble shooting procedures are carefully outlined in the manual, and complete voltage and resistance charts are included. According to Heath, 90% of the troubles that do arise





This bird's eye view shows several differences between the SB300 and SB301. The SB301 on the right has an additional heterodyne oscillator crystal and coil—immediately to the left of the large board. The converter switch which was located on top of the chassis in the SB300 is now located on the front panel. The three crystal filters of the 301 are somewhat smaller; the 6AS11 Compactron (below crystal filters) has been moved a little and is now adjacent to three crystals instead of the two that were used in the SB300.

are traced to poor soldering, so check that first.

Comparing the SB301 to the SB300

Owners of the older model will be interested in the differences between the two; physical changes are quickly apparent. On the front panel, the function switch and the AF gain control have been moved nearer the top. The AF gain knob also pulls out to turn on the ANL. The mode switch now has RTTY position and the band switch, its opposite number in location, includes the WWV 15 MHz position. At the bottom of the panel the converter switch is concentric with the rf gain control. It was formerly located on the top of the chassis and you had to open the lid to get at it.

Examine the top view photos of the two receivers; the holes in the coil cover indicate two things—coil locations have been shifted and an additional heterodyne oscillator coil appears. It is, of course, for the 15 MHz WWV position.

Three crystals appear in the chassis area of the 301 forward of the power transformer, where the 300 had only two. The extra one is for RTTY reception. Further forward in the same area, the three crystal filters are located. The new ones are not only smaller—but better. The 400 Hertz CW filter is now only 2 kHz wide 60 dB down, compared with 2.5 kHz in the old one.

The VFO in the receiver, which Heath calls the LMO (linear master oscillator), is a slightly modified version of the original model. An industrial grade 6BZ6 has been substituted for the original 6AU6, and there are some minor changes in the values of one or two parts. Its stability is excellent; drift is completely unnoticeable from a cold start.

Operation

One of this receiver's outstanding characteristics is its quiet operation, but don't make the mistake of thinking this means it's dead. Far from it—it's got sensitivity to spare. Tuning is smooth and the degree of tension on the dial is adjustable to your own tastes. With the receiver properly calibrated, frequency readout and resetability are outstanding, within a fraction of a kilohertz.

When you wrap the whole works up in the neat two-tone green cabinet Heath favors, you've got a receiver that's an impressive package for the money.

. . . W2JDL

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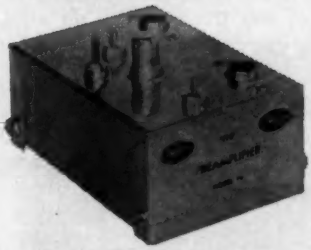
NUVISTOR LOW NOISE PREAMPLIFIER

For 27 (CB), 28, 50, 144 or 220 MC. (Also available for 150-170 MCS)



Add this Ameco Nuvistor Preamplifier to your receiver (or converter) to improve the sensitivity and noise figure. Two tuned circuits also improve rejection of image and spurious frequencies. Compact, easily connected and low power requirements, wired and tested with tube.

Model PV 27 ..... **$11.95**

Models PV 28, 50, 144 & 220 ..... **$13.95**

Write for details on 150-170 mcs and others.

Ideal for improving performance of surplus FM Two-Way equipment for "NET" operation on the 2 and 6 meter bands.

MANUFACTURERS OF FM AND AM TWO-WAY RADIO, SSB AND ISB COMMUNICATIONS, CONTROLATOR FUEL CONTROL AND DATA EQUIPMENT, AMECO* HAM, CB AND SHORT WAVE LISTENING EQUIPMENT.

AMECO EQUIPMENT CORP.

A SUBSIDIARY OF AEROTRON, INC. ■ P. O. BOX 6527 ■ RALEIGH, N. C. 27608

HEAVY DUTY POWER KIT FOR SSB EXCITERS

I am always on the lookout for electronic components or assemblies which possess potential ham value. I have also been interested in any item which makes it possible for more hams to enjoy sideband. You can, therefore, understand how happy I was when on a recent western trip I found one lot of 225 watt core power transformers and in another area a batch of computer grade electrolytic condensers. Immediately, I felt that we could put out a darned good universal transceiver power supply and when I got back, the boys in the shop confirmed this.

I say universal because with two of these power transformers and two 500 mil chokes, 12 diodes, assorted resistors and other components, we were able to make up a supply which met the requirements of the latest Swan, Collins, Drake, Hallicrafters, Heath, and National transceivers. Talk about value! We can offer this complete assortment of parts including a 16 gauge steel chassis and bottom plate, a good PM speaker and mating plugs for your particular transceiver for just $50. The transformers in this set weigh 17 lbs. and altogether the completed supply will weigh close to 40 lbs. This is what I call meat and potatoes. The filtering is excellent; the regulation is extremely good, and we have schematics and a printed story to be supplied with each kit, giving detailed information as to how to make the connections for your rig. You will have to tell us what model you own.

This is what the power supply will do:
800-1000 V at up to 400 mils on peak
285-320 V at up to 300 mils
bias of up to 125V at 100 mils
12V DC at 1 ampere
12.6V AC at 6.5 amps
Remember, this is an assembly of parts.

We do not furnish a drilled chassis; we do not furnish the hardware; we do not furnish the solder and the wire but literally everything else is supplied.

Please allow for 45 lbs. shipping weight or otherwise be prepared to accept Railway Express or motor truck shipment.

HIGH VOLTAGE PLATE TRANSFORMER

We pulled a booboo in our January catalog issue. We did not accurately describe a particularly good plate transformer and the result was that few people bought them. Actually one of the best items we have in stock, this plate transformer provides for 2850V either side of center, is rated for 500 mils of continuous duty, and is insulated for 4286V. The primary is intended for 207, 220, or 225V. This transformer will coast and run cool even with condenser input and a peak demand of your final at close to 4000V and upwards of one ampere. In other words, you can run 4KW PEP. It measures 9½" w. x 7⅜" d. x 9½" h. and weighs 60 lbs. Check the price of copper and steel today and see if this isn't a value. Only **$35 f.o.b.** Harvard. This is brand new merchandise.

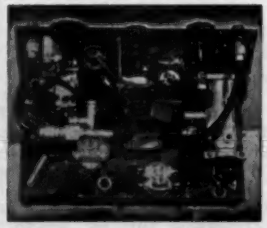
DON'T RUN OUT OF NUTS AND BOLTS

We have 500 boxes of ⅝" 6-32 thread nuts and bolts for $1.95 a box. These are heavily plated steel oval head bolts with square nuts to match. Used all the time in ham construction projects. Each box weighs 3 lbs. Please allow for postage.

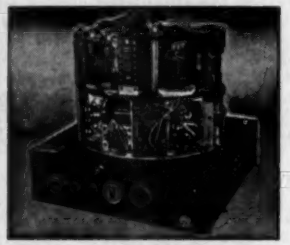
Herbert W. Gordon Co.

Woodchuck Hill, Harvard, Mass. 01451

Telephone: 617-456-3548

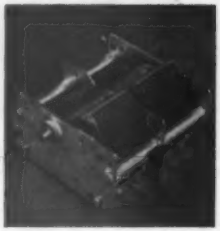


S Band Transponder. RT-21/APN-21XR Measures 13"W x 13"H x 10"D and weighs 21 lbs. Supplied less tubes. A veritable wealth of S band components —pulse transformers and generally useful components. Basic cavity may be used in amateur microwave work around 3000MC and uses light house tubes. A Shepard McNally Klystron 707B used in 2nd cavity. 12 or 24 VDC and 400 cycle 115V AC single phase. Bargain priced at $15.00.



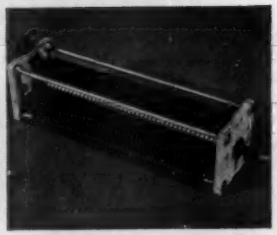
X-Band Radar. An early airborne radar set for X band includes receiver and pulse magnetron. Allow 100 lbs. $50.00 each. Here's your chance to have your own radar trap or weather eye. Requires 115V 400 cycles and 28V DC.

Loading Capacitor Here is a two-section loading condenser each section varying between 20 and 600 pf so that the sum of the condenser will extend up to 1200 pf which is more than adequate for most high-powered finals. The spacing is excellent. The condenser measures 3⅜" behind the panel. Its width is 3¼" and its maximum height with the condenser open is 2¾". This is straight line frequency. A particularly good value at $3 each. ¼" shaft. 2 lbs.



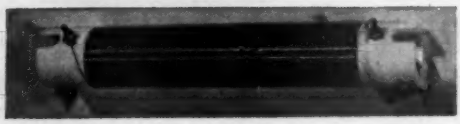
Bridge Rectifier Transformer suitable for solid state application. Capable of furnishing 600V at .5 amp; 115V primary; secondary rated at 545V at .455 amps. 5¼" square x 5" high. $7.25. 15 lbs.

Solid State or selenium rectifier transformer made by Raytheon, their #UX9115A; primary 60 cycles; secondary tapped, from 28 to 48V; rated 2 amps but good for 4 amps. 4½" high by 3¼" wide. $4 each. 7½ lbs.



G.E. Air Capacitor. 20-440 pf, 7" long x 2" x 2" ceramic end caps with ¼" shaft. Heavy brass construction, .015 spacing. Excellent as a loading capacitor or for general purpose work. $4/ea. 1½ lbs

Dual Bearing Hammarlund Capacitor. 100 pf straight line capacity. Excellent for a variety of general uses. 90c each, 10/$7.50. 4 oz. each.



Collins RF Plate Choke—good for high-powered final; capable of at least ½ amp and suitable for 80-10 meters. $4/ea. ½ lb.

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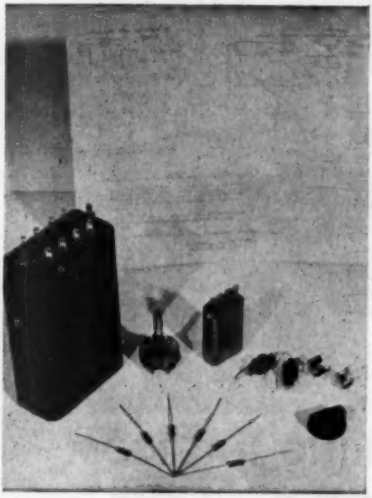
PHONE PATCH KIT ONLY $5.95

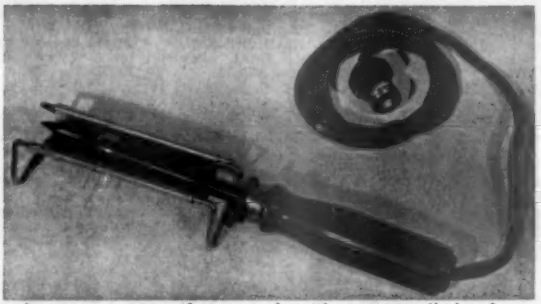


The most popular item that we have ever produced for the ham is our inexpensive phone patch kit. We have received literally hundreds of orders and many hams have taken the trouble to voluntarily write us to describe how pleased they were with the performance of the kit. The electrical values of this kit have been chosen for average volume and average telephone line conditions. Each kit is fashioned around a very expensive Western Electric repeating coil transformer. The transformer has four 600-ohm windings and is toroidally made with a great amount of shielding. Even when purchased in large quantities, the price of this transformer is over $40 and no contemporary phone patch made in this country includes a transformer doing more or costing more than this transformer. Besides the transformer, I supply a 4-pole switch and knob, six half watt resistors, two RF chokes, a blocking condenser, four ceramic capacitors and, naturally, an instruction sheet.

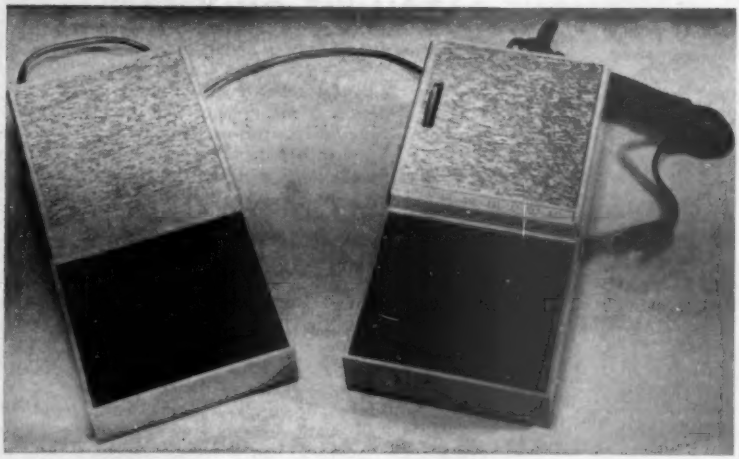
The patch is designed to work from the 500-ohm output of your receiver into a 500-ohm input on your transmitter. If you use a modern transceiver, we can supply two auxiliary transformers that will enable you to use this kit. One of them is a small 500-ohm to grid transformer priced at $2.50. You wire this into the microphone input circuit of your transceiver. The second transformer is a 500-ohm to voice coil transformer and it is used to contact the 3.2 to 8 ohm from your receiver output into the phone patch transformer. Price: $1.50.

A typical transceiver would normally require $9.45 worth of parts—$5.95 plus $2.50 plus $1.50. If you have an older type transmitter such as a Johnson, B&W, or Hallicrafters, you would very likely need only the kit itself. The kit, when packed with the auxiliary transformers, weighs 5 lbs. Those on the West Coast should add $1.70 for postage; those in the midwest, $1.30; those on the East Coast, $1.20.

AMERICAN BEAUTY 100 WATT SOLDERING IRON—$4.95



This famous iron has been standard in our trade for over 25 years. It will operate year in and year out without failure for it is built like the proverbial battleship. Especially well balanced for heavy use. Heavy enough to solder to a chassis and light enough for all general work. The soldering tip is iron plated which greatly reduces pitting and redressing and saves you time if you work with an iron all day long. The casing and body are of one-piece seamless steel. The shatter-proof wooden handle is coated with a durable rubberoid for personal handling comfort. Has a cooling baffle; uses an extra-flexible cord which withstands repeated kinking, and bending. Supplied with tip and stand. One of the most useful and best values I have ever offered. Absolutely new. $12.50 value—my net is $4.95. Allow postage for 2½ lbs. Only 275 available.



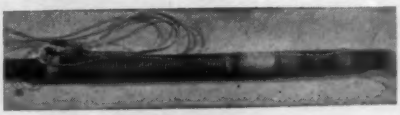
SIGNETTE LOUDSPEAKING INTERCOM

(Master, Remote and 50' of wire — only $20.00)

One of the surprise offerings made me in the past sixty days and which I have accepted for sale, is the small, solid-state intercom powered from the AC lines and made by General Dynamics in Rochester, New York. We offer our ham friends a truly worthwhile item which can be used in a variety of ways. Most hams set their shacks apart from their living quarters—in attic, garage, or basement. A big advantage of this little, inexpensive but high-quality, device is in having the XYL be able to reach you for dinner—or in reverse, during one of those contests when you want another pot of coffee, wouldn't it be nice just to reach over, push the

Radar Echo Box AN/UPM-30. A coaxial type resonant cavity used to monitor radar systems operating in the range of 1150-1350MC Decdy 3.5 lb per micro second. Sensitivity 1 db. power loss for 50 yard ringtime. Temperature coefficient .105% ringtime/degree F at 68°. Uses 3-IN21B diodes. New Weighs 25 lbs. Cost uncle $2000.00. Your Cost $70.00.

Oscillator 0-12. This is a signal generator operating between 155 and 235 MHz with a built-in attenuator assembly accurately calibrated to more than 100 db, below 1 volt. It employs a remote cutoff piston attenuator. These oscillators normally provide pulsed RF output but can easily be employed for CW with a simple change. $9.70. 7½ lbs.



Ferrite Antenna Coil: 6⅝" long x 5/16 diameter. I bought these at a very low price and found them to be particularly attractive when bunched together as a core for winding filament chokes. Use 4 of them wound with electrical tape as a core for 4-1000. 59¢ each. 4/$2.00. 4 oz. each.

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button, and ask for some Java without having to get up and lose your chance in the pile-up?

Another interesting application is using this as an automatic babysitter. If you wish, you can wire one through the walls of your home in such a way that people approaching your front door can have verbal entree to the kitchen where the XYL usually hangs out.

These little intercoms are ideal for stores, professional offices, small business, restaurants, grilles, garages or other office applications. The Master and substation units may be used in a variety of combinations. Instant operation and very low current consumption are features.

We offer, for $20, to supply one 1M Master and one 1R Remote. Also included will be 50' of 3-conductor triplex wire. You can use this little intercom at distances up to 225' as long as the interconnecting cable is made up of at least #22 wire. Technically, each Master comprises two transistors in cascade with a push-pull transistorized output stage. A 45-ohm dynamic speaker serves as a microphone on transmit. A small negative 12V power supply is obtained from a full wave rectifier and a tiny line transformer. The residual hum is negligible; the units are surprisingly clear, and sensitive enough so that a person speaking in a low voice four to five feet from a unit can be heard at comfortable volume at the other end of the line.

A Multi-Master intercom is available using the Model 7M which permits the selection of six stations, either Master to Master, or Master to Remote, or mixed Masters and Remotes. The 7M was originally priced at $50. We offer it for only $22.50. The little Remotes originally sold for $14.50 but when purchased on our special they are available at $6.75 each. The 1M and 1R combination which we sell for $20 can be wired for privacy mode or hands-free operation. In the hands-free position, you have an automatic listening device useful, for example, if you want to monitor the sounds coming from your baby's room.

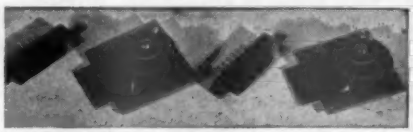
Each unit measures 4-3/16" w. x 7-25/32" d. x 2-5/16" h. There is a volume control on the master unit. Operation from either unit is effected by depressing the talk-listen plate or, in the case of the model 7M, by first selecting the remote and then depressing the plate. You may leave them plugged in and turned on all the time since they draw only 2 watts for the complete system. The transistors used are two pieces of 2N1414 and two of the 2N1415. The weight of the 1R and 1M when packed and shipped together is only 6 lbs. Remember to allow enough for postage and please give your street address in the event we can make shipment by United Parcel Service.

Just over 500 sets are available. These should go fast considering their quality and usefulness and the reputation of the original manufacturer. Remember this is new merchandise.

Matching transformers: Here is a very high quality line-to-grid transformer. Primary either 200 ohms or 500 ohms impedance and secondary 30,000 ohms grid-to-grid with a center tap. It may also be used as a low-level plate-to-multiple line transformer. UTC-4050 $2.50. ½ lb.

Sockets: RCA 9935 7 contact socket with built in capacitors. Semi-shielded for use with 829B, 3E29 and 832. Price $1.80. 100 available.

Toroidal Filter Assembly for RTTY. These new Humphrey units measure only 1¾" x 2". We have them complete with their sockets in matched sets tuned to 2125 cycles and 2975 cycles. $8.50 per set. ½ lb.



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INTEGRATED CIRCUIT SALE

GOOD STUFF YOU CAN AFFORD

IC's, Choice, TO-5 or TO-46 case, RTL Mostly 6 & 8 lead. Includes Gates, Buffers Flipflops, etc. 50 assorted **$5.95**
Buy 2 asstd. packs & get 8 pin test socket free.
IC's Flat Packs, DTL, Gates, Flipflops, Buffers, etc. 40 assorted **$5.95**
100 asstd. **$12.95**
All IC's sample test over 50% good, unmarked. Schematics, identification & test info included.
IC's TO-5 or **TO-46** Similar to 903 3 input NAN-NOR Gates. Tested. ..... **6 for $2.95**
Same as above, Sample tested over 50% good. **50 for $5.95**
IC's Flat Packs sim. 931 RS/JK Clocked Flipflop, tested ..... 10 for $12.50 ..... **2 for $2.95**

FOLLOWING HAPPY PACKS WILL RESTORE YOUR FAITH IN SURPLUS DEALERS. All $2.95 each. Buy 10 and get #11 free. Some tested, some sample tested (ST), but include extras.
Hi-Gain (Darlington) Amplifiers TO-18 similar 2N998, 2N999. 4 lead. Tested ..... **6 each**
P Channel Field Effect Trans. similar 2N3277, 2N3278, TO-5, 4 lead. Tested ..... **3 each**
NPN Power Trans. HV Amplif. 20 MHz, 30 watts Tested, Beta 25 to 75. TO-59 stud ..... **6 each**
Same Pwr. Trans. Tested Beta 75-100 plus, 4 each.
NPN Pwr Trans. HV Choice TO-3 diamond, 15 watt or TO-66 Small diamond 5 watt test 21-50 Beta, **6 ea.**
Pancake Trans. tiny TO-46, choice all PNP or NPN, tested ..... **30 each**
Fast Switch Trans. sim. 2N914/NPN, TO-52, tested **12 each.**
NPN TO-5 or PNP TO-5. Various types test, **35 ea.**
NPN TO-18 or **PNP TO-18,** Various types including UHF. Tested ..... **35 each.**
Asstd. NPN-PNP sample tested, choice, all TO-18 or all TO-5 ..... **over 45 each.**
Dual Trans. 6 lead. Choice. All TO-5 or TO-18 NPN, or PNP. Choice. Dif. Amp. types tested **6 each.**
Dual Trans. Choice All TO-5 or TO-18, mixed PNP & NPN (ST) ..... **20 each.**
Power Trans. NPN Asstd. TO-59 Stud, TO-3 and TO-66 Diamond Tested, low Beta ..... **15 each.**
Dual Computer Diodes, 3 lead, TO-18 case, mostly fast. Common Anode. (ST) ..... **75 each.**
Signal Diodes, mostly fast, Asstd. Glass & Tiny black dot (ST). Few Zeners ..... **100 each.**
Above Devices all new, unmarked, all silicon.
SCR's, tested for PIV, PRV & Gates. Your choice TO-5 1.2 to 1.5 amp. TO-66 Diamond, 5 ampere TO-59 Stud, 8 amp. All packs **$2.95**

Choice all one type:

50 to 100 PRV	.6 each.
100 plus to 200 PRV	.4 each
200 plus to 300 PRV	.3 each
300 plus to 400 PRV	.2 each

Silicon 10-32 Stud Diodes Tested ..... **$2.95 pkg.**

PIV	5 Amp.	10 Amp.
50 plus to 100 PIV	12 each	
100 plus to 200 PIV	10 each	6 each
200 plus to 300 PIV	8 each	5 each
300 plus to 400 PIV	6 each	4 each
400 plus to 500 PIV	5 each	3 each

We include some Rev. Polarity.

Germanium Diodes, IN-270, 100 PIV, 90 ma. all purpose type ..... 50 each **$2.95**
Germanium Transistors, TO-5 ..... **$2.95 pkg.**
Sprague, 2N1754, PNP, RF ..... **10 each**
Gen. Inst. 2N604 PNP, 50MHz SW ..... **10 each**
Tex. Inst. 2N1303 PNP HI Gain ..... **10 each**
Above new marked long leads.
TEX. Inst. 2N1304 NPN GP, new ..... **20 each**
TEX. Inst. 2N1305 PNP GP, new ..... **25 each**
Asstd. Marked PNP, NPN (ST) ..... **50 each**
Last 3 items have short leads PC bd. or socket length.

Assorted types of Goodies ..... **$2.95 pkg.**
Miniature Trimpots by Bournes, Dale, Daystrom, etc. Mixed new and used pull-offs.
20 ohm to 500 ohm **10 asstd.**
1000 ohm to 10,000 ohm **10 asstd.**
20,000 ohm to 1 meg ohm **10 asstd.**
Slug tuned coils, wired, from Gonset, 7 varieties **25 asstd.**
Disc Capacitors top grade, Erie, 600V 5% 60 to 320 mmf. 7 varieties ..... **60 asstd.**
Dipped Micas (Hershey Bars) mostly 100, 220, 330 mmf 100 V new trimmed for PC boards, **125 asstd.**
Good—All subminiature **Mylar Capacitors**
200 V precision, 2% ratings.
.026, .047, .055 mf
30 asstd., 10 of each or 30 of a type **$2.95**
Precision Resistors, 2% ½ watt
All marked 47 ohm thru 470K ohm short leads. 300 asstd. **$2.95**
88 mhy Toroid coils 1" diam
Excellent re-wind cores ..... **10 for $2.95**
Ferrite Cores for Pulse Xfmr windings. ¼" x 1" rods, ⅜" x ⅝" round toroids and ⅜" x ¾" E cores. 25 asstd. **$2.95**
Some memory cores included free.

NE-2 Neon Lamps, 300 each mounted in 8" x 12" Micarta Panel. Removable. 4 lbs. **$4.95**
Nicad Rechargeable battery 1.25 V mounted in reject Elect. Toothbrush with motor, some usable units. ½ lb each **$1.00**
Buy 10 and get free battery charger

Memory Plane, 5" x 8" with 4096 wired toroid bits, $9.75 each. Complete 8 plane unit **$75.00**
Memory Plane, 10" x 10" with 10,000 wired toroid bits. Perfect condition. 1 lb. each **$15.00**
Same Memory Plane slightly damaged, 2 for **$15.00**
Same Memory Plane badly damaged each ..... **$ 5.00**
2"x3" 10x10 (100 bit) **Matrix** boards ..... **$2. each**

MIKE QUINN ELECTRONICS

Building 727, Langley Street **Oakland Airport, California 94614**

Computer Grade Elect. Capacitors. 2" x 5" by Mallory, Sprague and G.E. **each $1.25,** ½ lb.

36,000 mfd 4 VDC	4,500 mfd 55 VDC
25,000 mfd 6 VDC	2,500 mfd 80 VDC
19,000 mfd 6 VDC	1,250 mfd 180 VDC
3,500 mfd 55 VDC	500 mfd 310 VDC

Transistor Ignition System .....less coil **$2.95** with 3"x5" finned heat sink, 2 power trans. TO-3 & TO-36 plus control trans. fully wired. with by-pass capacitor & res. for 6 or 12 VDC, Including Heathkit Ignit. Manual, 36 pg, 1 lb.

Dialco or Eldima 10 V 14 ma. Tiny ¼"x1" stove-pipe panel lights with mount clip. Ok for 12 to 28 volts .....**15 for $2.95**

Grayhill Minn. Rotary Switches, both new and used. Nice assortment of 10 .....**$2.95**

Jumbo Silicon Trans. Assortment. 450 asstd. **$9.95** Includes PNP & NPN in TO-18, 46, 52 & TO-5. A few Power Trans. Darlingtons, 6-lead dual Trans. and a few FETs, SCRs & Integ. Circuits and about 50 diodes. These are sample tested, and will run from 50% to 90% good depending on type. This is good stuff and we get many re-orders on this mixture. Buy 2 assortments and get a Pomona flare top transistor test socket free. 1 lb.

WEIRD-O EXPERIMENTER ASSORTMENT.
Over 100 .....**$4.95**

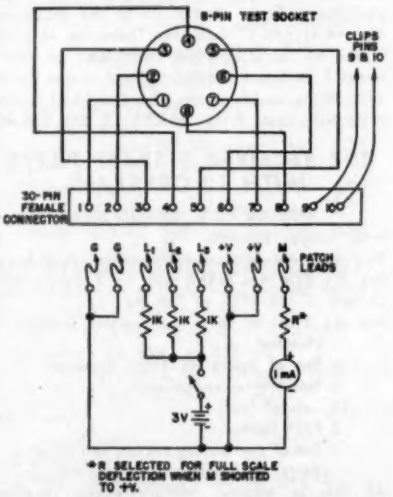
We get loads of odd types of special products like resistor arrays or diode arrays in multilead TO-5 cans. Tiny flatpack dual transistors, flatpack single trans. & other multi-lead pkgs. A real nutty assortment containing some mightly good stuff.

Brand New Selenium Rectifier Stacks. 8 plate to 50 VDC 3 to 4 amp., $3.95. 4 to 5 amp, **$4.95,** 1 lb. each. 15 amp., $6.95, 3 lbs. All FWB.
G.E. Germanium FWB Stacks 2"x4" long., 5.2 amp to 40 VDC or 4.2 amp to 70 VDC, each **$2.95**

New Copperclad PC Boards.	Easy Etch
3"x6"—5 for **$1.00**	4"x6"—4 for **$1.00**
4"x8"—3 for **$1.00**	6"x8"—2 for **$1.00**

IC TESTER

Here's simple little tester capable of testing or identifying a wide variety of logical integrated circuits.



While this was built to test TO-5 RTL units, it can easily be extended to DTL or TTL by increasing the supply voltage (especially with flip-flops; these families require 5 or 6 volts). The use of the "patch board" is the factor that makes this tester so versatile: resist the temptation to use push buttons or switches!

The best way to sort TO-5 cans is to separate them first according to lead configuration, then go through each set of similar appearance. This minimizes reconnections. A good procedure is to connect +V to pin 8, and ground pin 4, (This is for 8-lead units. For 10-lead cans put +V on pin 10 and ground pin 5.), then with the M lead explore for likely voltages on pins 7, 6, 5, 3, 2 and 1, in that order. When you find a voltage of about 0.2 or a voltage over 1.3, watch the voltage on that terminal while applying one of the L leads to the blank pins. If you see no change, try applying two L leads at the same time to various combinations of free terminals. Generally, once you get the hang of it, the right (most probable) connections seem fairly obvious. Every now and then a unit requires the use of both +V leads; in this case try one on pin 8 and the other on pin 6.

Most TO-5 cans sold unmarked seem to be the 8-lead cans, although several valuable types come in 10-lead cans. Ten pin test sockets are not necessary if you use separate clips, as in the diagram.

For a complete discussion of the various families of integrated logical circuits, see Electronics Magazine for 6 March 1967 and 73 Magazine for March and June 1967.

In surplus business 21 years now. We guarantee satisfaction on all sales. Please add approximate postage where weight is shown. On other assortments add 10¢ to each price and we will make up any difference. Minimum cash order $5.00. Minimum COD with $5.00 deposit is $20.00. Minimum School or Company purchase order is $20.00. Minimum foreign order $20.00. California orders, add 4% Sales Tax. Most of our semiconductors are silicon.

We're working on a new catalog and hope to have it ready soon. Send for it; postage *appreciated.*

In ordering, you can list the items you want or if you wish tear out these sheets, mark them and we will return them with your order.

MIKE QUINN ELECTRONICS

Building 727, Langley Street **Oakland Airport, California 94614**

PREMIUM SILICON REPLACEMENTS

5R4 Ratings 4000V. PIV 1 AMP 5R4WGY
IMMEDIATE AND DIRECT PLUG-IN!
INSTANT OPERATION

NO: REWIRING NECESSARY
NO: FILAMENT TRANSFORMERS NEEDED

—PROPERLY COMPENSATED—

Our tubes are UNAFFECTED by VIBRATION or HUMIDITY
Potted in HYSOL Electrical Epoxy
All our tubes are power tested at 1 AMP average current.
END Vacuum Rectifier Tube REPLACEMENTS.
Price: $6. Quality prices on request.
Other tube replacements available.

OUR S/A SILICON DIRECT TUBE REPLACEMENTS

Replaces the following tube types: 5Y3, 5U4, 5Y3GT, 5V4, 5V4GT, 5AU4, 5T4, 5W4, 5Z4, 5AW4, 5V3, 5AS4, 5AX4, 5AZ4. Rates 1800 P.I.V. at 1 amp.
Price $1.95 each or 10 for $16.00.

FLANGELESS SILICON DIODES

All rated at 1.5 amps.

50-200 volts	6¢ each	20/$1.00
200-400 volts	9¢ each	15/$1.00
400-600 volts	12¢ each	10/$1.00
600 plus	15¢ each	7/$1.00

RACK CABINET AND BLOWER

BRAND NEW 19" desk top rack cabinets that contain a NEW Rotron muffin fan with attached cord and plug for 115V 50-60cy, mounted on the rear door. There is also a top door, 2 drawer rails with ball bearing rollers (removable), 3 alignment tools and 2 Allen wrenches. Front panel space is 19" wide x 14" high with a 13½" clear behind panel depth. The outside measurements are 16" high x 21" wide x 15" deep. There are four rubber feet on the bottom, and the color is dark gray.
Price ..... $14.95 each

ARC-5 TRANSMITTER LIKE NEW 3-4 mHz

Complete with all tubes. One of the most versatile pieces of surplus equipment ever. Get yours now—not many of these left. Guaranteed excellent. Price $12.95

HAMMARLUND VARIABLE CAPACITORS

Brand new in original cartons
All have ⅜" bushing with standard ¼" dial shaft:

Butterfly type	Price each
BFC-25	$ .75
BFC-50	1.00

Single type	Price each
HF-50	$1.25
HF-100	1.50

NEW INSTRUMENT OR RECEIVER TRANSMITTER CABINET

Panel space 19" wide x 12½" high with a clear depth of 13". Outside depth is 14½". Partial rear panel. Painted black crackle.
Price: ..... $3.95 each

NEW CRYSTALS

100 crystals in a case originally for type MAR equipment. These crystals cover the range of 4844.44 kHz to 7778.78 kHz. There are 16 units in the 40 meter amateur band, and an additional 7 units are usable in the 6 meter band. Also 17 are usable in the 10 meter band. Complete with case. Price: $12.95 2 for $25.00

RDR RECEIVER & SPARE PARTS WITH 10 CRYSTALS

Mfg. by RCA BRAND NEW
Freq. range: 225-390 mHz.
You get two wooden crates which include:
Box #1 RDR RECEIVER with 13 V dynamotor.
Output is 385 VDC at 500 ma.
Box #2 1 set of spare parts which include:
- 1 Headset
- 1 Set of operating tubes (spares).
- 1 Headset extension cord
- 10 Sets of fuses
- 2 Pilot lights
- 1 Set of connecting cables, and other parts too numerous to mention.

All this in original military boxes, receiver packed in aluminum waterproof case, manual included. Easily converted to 200 mHz ham band, or use as they are for UHF aircraft band. You get all that is required to operate except the 12 V DC source and the antenna.

BRAND NEW
Price: $34.95 ea. while they last FOB our warehouse.

SELECTRONICS

1206 S. NAPA STREET, PHILA., PA.
HO 8-7891 HO 8-4645

DESK TOP RECEIVER OR TRANSMITTER CABINET

A modern design desk top cabinet with a top lid and rounded corners and painted a light gray. These cabinets are made of perforated steel on side and top for adequate ventilation. The panel space is 8¾" H x 18" W with 15" depth behind panel. Also, a bottom chassis cover is supplied. These units are BRAND NEW.
PRICE: .....**$2.95 ea. or 2/$5.00**

SUPER DELUXE CABINET RACK

These cabinets are a blue-gray finish with front and rear doors and a complete filtered air blower system in the base with suitable duct on the rear door to distribute air as required throughout the cabinet.
The outside dimensions are:

Height	approx.	93"
Width	"	24"
Depth	"	24"

The panel space is 19" x 76" with approx. 15½" behind the panel.
USED, EXCELLENT CONDITION
PRICE: .....**$79.95** F.O.B.

PANEL METERS ALL NEW

2½" round, 30 amps AC Tripplett, ea. **$3.95**
3½" round, 1 amp RF G.E., ...ea. **4.95**
3½" round, 3 amps RF Simpson, ...ea. **4.95**
0-400 feet, but easily changed,
Weston, ...ea. **2.95**
3½" round, 1.5 amp AC Weston, ...ea. **2.95**
2½" round, 35 VDC Bruno Ind. .....ea. **2.50**

MINIATURE POWER SUPPLY KIT

A set of electronic parts to build a small power supply useful for transistor work.
Input: 117 VAC 60 cycle
Outputs: 12.5 VDC at 630 ma
100 VDC at 8 ma
55 VDC at 31 ma
Parts supplied:
1 transformer
5 diodes
2 filter capacitors (1 ea. 40 mfd & 100 mfd.)
Schematic with directions supplied.
Price: .....**$3.95 each, or 2 for $7.00**

TELETYPE DEMODULATOR UNIT

Northern Radio type 104 model 3
11 tubes
115 or 230 V 60 cy operation
GOOD CONDITION
Price: .....**$49.95** Shipping wt. 50 lbs.

TDA-2 RTTY—TEST SCOPE

The Stelma Telegraph Distortion Analyzer type TDA-2 is a self contained portable unit designed to measure bias and distortion of telegraph start-stop signals. Distortion is indicated by vertical pips displayed in a rectangular pattern on the face of a cathode ray tube. Measurements can be made while the machine is operating. Measurements can be made on circuits operating at 60, 75 or 100 OPM on 20 or 60 ma neutral circuits or 30 ma polar circuits. Distortion measurements from zero to 50 percent with an accuracy of plus or minus two percent can be made. The set is patched in series with the loop and direct measurements made. No special skills required to make measurements after a few minutes practice. See your distortion, then adjust and watch it disappear.
Price: .....**$49.50** F.O.B.

POWER TRANSFORMER STANCOR #PC-8412

Primary: 117 VAC 60 cy
Secondaries:
Plate: 400-0-400 VDC at 200 ma
Fil.: 5.0 V at 3 A AC
6.3 V at 5 A AC
Upright mounting base area 4" x 4"
Price: **$3.95**

PLATE TRANSFORMERS

Input: 110/220 60 cy 1 ph
Secondary: 2500-0-2500, 500 ma
Size: 11½" H x 7" D x 9" W
Price: **$19.95** or **2/$35.00** Ship. Wt. 100 lbs

TRANSFORMERS

1000-0-1000 or
1200-0-1200
200 ma, CCS
110 or 220 volts
Price: **$9.95**

WESTON R.F. AMMETERS

A brand new 3½" round panel meter with external thermocouple unit calibrated for 200 R.F. amps. Full scale with the lowest scale reading 20 amps. Weston model 1533 meter and thermocouple. These units are of particular interest to broadcast stations, and induction heater users. There is negligible frequency error up to 30 mHz, and approx. 2% error up to 75 mHz.
Price: .....**$24.95** Shipping wt. 5 lbs.

SELECTRONICS

1206 S. NAPA STREET, PHILA., PA.
HO 8-7891 **HO 8-4645**

READ CAREFULLY ABOUT JAN CRYSTALS

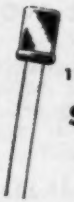
All JAN Crystals listed were manufactured for the Armed Services and were made by America's leading crystal manufacturers to the rigid specifications of the government. The specifications in most cases call for .005% or better tolerances over a temperature range of −55° to +90° Centigrade. This means that the crystals must be cut at the proper X-rayed angles and processed to all specifications, many of which are more rigid than those required for commercial crystals.

Every crystal listed has passed these government tests and was accepted by inspectors. You are assured of a quality product when you buy JAN Crystals. We receive crystals in the original packing, unused, as they are released from time to time as excess to the government's needs. Every JAN Crystal is tested for output and frequency using the latest type frequency counters. Many persons do not understand that a crystal may be changed in frequency by adding or subtracting capacity to the oscillator circuit. Unless otherwise stated the crystals listed were designed for a circuit of 32 mmfd capacity and when operated in such an oscillator JAN Crystals will be on frequency.

This chart shows how far a crystal will change frequency with a change of capacity in the oscillator circuit.

MEASURED CRYSTAL FREQUENCY IN KC

10 MMFD	20 MMFD	STANDARD 32 MMFD	50 MMFD
2000.200	2000.060	2000	1999.950
3000.600	3000.200	3000	2999.800
4001.000	4000.400	4000	3999.700
7003.300	7001.200	7000	6999.200
14008.1	14003.1	14000	13998.0



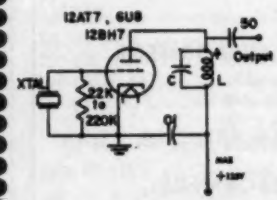
HC18/U

Wire Leads

1½" for soldering

$1.60 EA.

4 for $5.00



FREQ. IN MC								
	14.950	28.000	36.850	40.6296	42.1480	53.2070	57.8500	80.9925
	16.000	28.250	36.900	40.6666	42.2500	53.2575	58.0500	81.0000
	16.250	28.750	36.950	40.8888	42.3333	53.3070	58.3830	81.9925
	16.500	29.000	38.1481	41.0000	42.4000	53.3833	59.0500	82.0000
	16.750	29.250	38.3333	41.0500	42.4500	53.3575	59.3830	82.9925
	16.950	29.500	38.4814	41.1000	42.5185	53.4070	59.7160	83.0000
	17.000	29.750	38.6296	41.1111	42.5500	53.4620	60.0000	83.9925
	17.050	30.000	38.7375	41.1500	42.6500	53.4575	60.0500	84.0000
	17.100	30.250	38.9250	41.2000	42.7500	53.5075	60.3830	85.0000
6.280	17.150	30.750	38.9629	41.2222	42.8500	53.5575	60.9875	86.0000
7.255	17.200	31.250	39.0000	41.2500	42.9500	53.6070	61.0500	87.0000
7.280	17.250	31.750	39.0740	41.3000	44.7400	53.6575	61.6750	88.0000
8.250	17.350	33.000	39.1111	41.3333	45.5000	53.7075	62.1500	89.0000
11.666	17.400	33.100	39.1851	41.3500	46.2600	53.7160	64.9920	90.0000
14.000	17.450	33.200	39.2222	41.4000	46.4000	53.7575	65.9925	94.5000
14.050	17.500	33.300	39.2591	41.4500	48.3750	53.7920	66.9925	96.0000
14.100	17.550	33.400	39.2963	41.4814	48.3833	53.8075	67.0250	97.0000
14.150	17.600	33.500	39.4074	41.5000	48.4666	53.8575	67.1250	98.0000
14.200	17.650	33.600	39.4814	41.5500	48.7160	53.8920	67.9920	99.0000
14.250	17.750	33.700	39.5555	41.6000	48.9675	53.9075	68.9920	99.8667
14.300	17.850	33.800	39.6296	41.6500	49.0500	53.9575	69.9925	103.0600
14.350	18.000	33.900	39.6666	41.6666	49.3833	53.9590	70.7375	103.2600
14.400	18.250	34.322	39.7777	41.7000	49.7166	54.0500	70.9925	103.4600
14.450	20.4083	34.444	39.8148	41.7500	50.0500	54.3833	71.9925	103.6667
14.500	20.500	34.100	39.8500	41.8000	50.7500	54.7160	72.9925	103.8600
14.550	20.750	36.200	40.0370	41.8518	52.9000	55.0500	73.9925	104.1667
14.600	23.750	36.300	40.1111	41.8888	52.9000	55.3830	74.9925	104.2600
14.650	24.750	36.330	40.1851	41.9000	52.9920	55.7160	75.9925	104.4600
14.700	24.900	36.400	40.2222	41.9500	53.0070	56.0500	76.9925	104.6600
14.750	25.250	36.630	40.2963	42.0000	53.0500	56.7160	77.9925	111.0000
14.800	26.750	36.700	40.3703	42.0500	53.0570	57.3830	78.9925	111.2500
14.850	27.250	36.780	40.4074	42.0740	53.1070	57.7160	79.9925	112.0000
14.900	27.500	36.800	40.4444	42.1111	53.1570	57.8000	80.0000	132.7500

NOTICE

Due to the shortage of quartz we will buy all type HC6/U crystals or miniature crystals with 1½" leads at 15c each, or we will allow you 25c each, credit on your orders, for any crystals listed in our catalog.

Send unusable crystals to:

Jan Crystals
2400 Crystal Drive
Fort Myers, Florida 33901

HOW TO ORDER...

ADD 5¢ PER CRYSTAL FOR POSTAGE OR 10¢ PER CRYSTAL FOR AIRMAIL

Order your crystals by type and frequency . . . enclose check or money order (No C.O.D.) . . . add 5¢ per crystal for postage, 10¢ per crystal for airmail . . . make check or money order payable to JAN CRYSTALS, 2400 Crystal Drive, Fort Myers, Florida.

PHONE AREA 813 WE 6-2397

JAN CRYSTALS

CR1A/AR

Pressure type crystal used in SCR-522, etc.

75c EACH

3 for $2.00

The following frequencies are in stock for immediate delivery, frequencies guaranteed ±1 KC as listed in kilocycles.

5620	6510	7340	7743	8103	8264	8361	8436	8570
5645	6511	7370	7785	8115	8269	8367	8446	8575
5690	6520	7372	7850	8133	8270	8368	8449	8580
5700	6522	7380	7855	8138	8272	8378	8446	8592
5710	6527	7405	7860	8146	8278	8388	8449	8598
5780	6539	7438	7910	8148	8284	8383	8452	8622
5820	6550	7440	8001	8154	8285	8385	8463	8630
5835	6627	7505	8002	8162	8301	8389	8464	8645
5950	6635	7516	8006	8170	8306	8395	8465	8650
5960	6680	7520	8007	8177	8307	8405	8476	8660
6040	6694	7540	8008	8185	8310	8407	8477	8686
5050	6727	7550	8029	8192	8315	8408	8486	
6160	6750	7565	8030	8198	8320	8409	8492	
6180	6860	7570	8036	8200	8328	8410	8494	
6200	7030	7580	8037	8212	8330	8416	8512	
6240	7033	7600	8045	8224	8344	8425	8530	
6250	7083	7620	8046	8225	8345	8428	8541	
6260	7210	7660	8050	8228	8353	8430	8547	
6440	7230	7695	8086	8236	8350	8431	8550	
6460	7300	7705	8092	8262	8357	8435	8560	

LOW FREQUENCY PRESSURE TYPE CRYSTALS

TYPE 243

$1.05 EACH

FREQUENCIES ARE IN KC. ORDER BY FREQUENCY

FREQUENCIES LISTED ARE IN STOCK FOR IMMEDIATE DELIVERY

1130	1305	1930	2065	2520	2665	2975	3480	3595	3705	3815	3925	4030	4145
1170	1340	1935	2070	2540	2670	2980	3485	3600	3710	3820	3935	4040	4150
1220	1365	1940	2095	2545	2675	2985	3490	3605	3715	3825	3935	4045	4165
1225	1370	1950	2060	2570	2680	2990	3490	3610	3720	3830	3940	4050	4160
1235	1375	1955	2060	2575	2685	2995	3500	3615	3720	3835	3945	4055	4165
1240	1380	1960	2070	2580	2690	3000	3510	3620	3730	3840	3950	4060	4170
1245	1390	1965	2075	2585	2695	3005	3515	3625	3730	3845	3955	4065	4175
1250	1395	1970	2080	2590	2700	3010	3520	3630	3740	3850	3960	4070	4180
1260	1400	1975	2085	2595	2705	3015	3525	3635	3745	3855	3965	4075	4185
1265	1405	1980	2090	2600	2710	3020	3530	3640	3750	3860	3970	4080	4190
1270	1410	1985	2095	2605	2715	3025	3535	3645	3755	3865	3975	4085	4195
1275	1440	1990	2100	2610	2720	3030	3540	3650	3760	3870	3980	4090	4200
1285	1515	1995	2105	2615	2725	3035	3545	3655	3765	3875	3985	4095	
1290	1790	2000	2110	2620	2730	3040	3550	3660	3770	3880	3990	4100	
1300	1830	2005	2115	2625	2735	3045	3555	3665	3775	3885	3995	4105	
1305	1840	2010	2120	2630	2740	3050	3560	3670	3780	3890	4000	4110	
1310	1890	2015	2125	2635	2745	3055	3565	3675	3785	3895	4005	4115	
1320	1900	2020	2130	2640	2750	3060	3570	3680	3790	3900	4010	4120	
1325	1905	2025	2135	2645	2755	3065	3575	3685	3795	3905	4015	4125	
1330	1915	2030	2140	2650	2760	3070	3580	3690	3800	3910	4020	4130	
1335	1920	2035	2145	2655	2765	3075	3585	3695	3805	3915	4025	4135	
1340	1925	2040	2150	2660	2770	3080	3590	3700	3810	3920	4030	4140	

PLEASE SPECIFY YOUR SECOND CHOICE IN CASE WE DO NOT HAVE FREQUENCY ORDERED.

SUB-MINIATURE CRYSTALS IN HC-18/U TYPE HOLDERS MOUNTED ON A WAFER SWITCH ASSEMBLY. HIGH QUALITY CLOSE TOLERANCE CRYSTALS. MANUFACTURED FOR AVIATION TRANSCEIVER USE. ALL CRYSTALS MOUNTED ON A PRINTED CIRCUIT COMPACT SWITCHABLE UNIT. ALL CRYSTAL FREQUENCIES LISTED IN MEGACYCLES.

CRYSTAL WAFER ASSEMBLY # 1

88.00	98.00	108.00
89.00	99.00	109.00
90.00	100.00	110.00
91.00	101.00	111.00
92.00	102.00	112.00
93.00	103.00	113.00
94.00	104.00	114.00
95.00	105.00	115.00
96.00	106.00	
97.00	107.00	

20 crystals - $ 35.00

CRYSTAL WAFER ASSEMBLY # 2

88.00	98.00
89.00	99.00
90.00	100.00
91.00	101.00
92.00	102.00
93.00	103.00
94.00	104.00
95.00	105.00
96.00	106.00
97.00	

19 - $ 25.00

CRYSTAL WAFER ASSEMBLY # 3

82.00	91.00
83.00	92.00
84.00	93.00
85.00	94.00
86.00	95.00
87.00	96.00
88.00	97.00
89.00	98.00
90.00	99.00

18 - $ 24.00

CRYSTAL WAFER ASSEMBLY # 4

36.00	36.50
36.10	36.60
36.20	36.70
36.30	36.80
36.40	36.90

10 - $ 15.00

CRYSTAL WAFER ASSEMBLY # 5

16.90	17.50
17.00	17.60
17.10	17.70
17.20	17.80
17.30	17.90

10 - $ 15.00

CRYSTAL WAFER ASSEMBLY # 6

26.00	28.50
26.50	29.00
27.00	29.50
27.50	30.00
28.00	

9 - $ 14.00

CRYSTAL WAFER ASSEMBLY # 7

82.00	87.00
85.00	88.00
84.00	89.00
85.00	90.00
86.00	

9 - $ 14.00

ORDER BY ASSEMBLY NUMBER

CRYSTAL STUDYING AND GRINDING KITS

	Kit #1	Kit #2	Kit #3
Crystals in misc. holders	12	20	33
Assorted crystal blanks	6	12	15
Pkg. ammonium bifluoride flakes	1	2	3
Packet grinding compound	1	2	3
Plastic containers	2	3	5
Wooden crystal blank holders	2	4	6
Instructions	$ 3.95	$ 7.50	$12.50

HIGH QUALITY CRYSTAL OVENS

THE OVENS LISTED ARE NEW AND FULLY GUARANTEED. PRICED AT A FRACTION OF THEIR ORIGINAL COST.

STOCK NO. LA-1 LaPOIE OVEN FOR BASE STATIONS 115 VOLTS AC 60 TO 1000 CYCLES DIMENSIONS- 4" HIGH X 1 7/8 X 11/2 FITS OCTAL SOCKET. 72° C. REGULAR PRICE $ 35.00 ..... $ 10.00 EA.

STOCK NO. JK-2 JAMES KNIGHTS 70°C, OVEN 6.3 V AC OR DC. FITS OCTAL SOCKET. FOR ONE CRYSTAL ..... $ 2.50 EA.

STOCK NO. HO-3 HOLOVA 55° OVEN C. 117 V AC FITS OCTAL SOCKET .. $ 2.00 EA.

STOCK NO. HO-4 HOLOVA 70° OVEN C. 12 V DC FITS OCTAL SOCKET .. $ 2.00 EA.

Send 25¢ for 68 page RELAY SALES catalog

2400 Crystal Drive

Fort Myers, Florida 33901

THIRD OVERTONE CRYSTALS — HC6/U HOLDERS

$1.50 EA.

4 for $5.00

The CR23/U is a third or fifth overtone crystal designed to operate in a series overtone circuit, 3rd overtone from 10 to 52 MC, 5th overtone 52 to 75 MC, .005% tolerance, from −55° to +90° C. Maximum drive 5 milowatts. Listing in MC.

IN STOCK FOR IMMEDIATE DELIVERY

11.3562	24.911	30.625	33.225	36.444	39.666	42.900	44.814
11.4310	24.922	30.644	33.250	36.450	39.703	42.916	44.850
11.4566	25.266	30.666	33.325	36.481	39.740	42.925	44.888
11.4810	25.535	30.675	33.300	36.518	39.777	42.962	44.925
11.5812	25.692	30.688	33.333	36.555	39.814	43.000	45.000
11.6812	25.700	30.700	33.350	36.592	39.851	43.037	45.275
12.4777	25.711	30.725	33.375	36.629	39.888	43.074	45.700
15.3250	25.861	30.775	33.400	36.666	39.907	43.111	45.850
15.4350	25.945	30.822	33.425	36.703	39.925	43.185	45.883
15.5060	26.120	30.825	33.444	36.740	40.037	43.148	46.083
16.5060	26.162	30.866	33.450	36.777	40.074	43.222	46.275
16.9999	26.220	30.875	33.600	36.814	40.148	43.259	46.850
17.0060	26.241	30.925	33.625	36.851	40.185	43.277	46.895
17.4000	26.533	30.955	33.700	36.888	40.222	43.296	47.187
17.5060	26.666	30.975	33.750	36.925	40.259	43.407	
18.1500	26.703	31.075	33.800	36.936	40.296	43.444	47.700
18.4278	27.006	31.100	33.850	36.962	40.333	43.481	47.812
18.4350	27.120	31.111	33.900	37.000	40.370	43.518	47.850
18.5500	27.158	31.125	33.930	37.037	40.407	43.555	47.888
18.5833	27.220	31.133	34.000	37.074	40.444	43.592	47.900
19.0060	27.319	31.175	34.200	37.111	40.445	43.629	47.927
19.9350	27.455	31.200	34.300	37.148	40.481	43.703	47.937
19.9999	27.629	31.225	34.400	37.185	40.518	43.740	48.012
20.0060	27.666	31.275	34.488	37.222	40.555	43.750	48.187
20.316	27.700	31.375	34.511	37.259	40.583	43.777	48.700
20.435	27.725	31.525	34.555	37.266	40.592	43.814	48.850
20.533	28.555	31.575	34.588	37.296	40.629	43.850	48.958
20.555	28.620	31.666	34.688	37.333	40.666	43.888	49.611
20.616	28.700	31.675	34.700	37.370	40.703	43.900	49.700
20.700	28.725	31.700	34.722	37.407	40.740	43.925	49.730
20.777	28.888	31.888	34.866	37.444	40.778	43.962	49.850
20.803	29.000	32.222	34.888	37.481	40.814	44.037	49.888
20.935	29.525	32.225	34.922	37.500	40.833	44.074	49.900
20.977	29.575	32.250	35.629	37.518	40.851	44.111	49.906
21.030	29.600	32.275	35.666	37.555	40.888	44.148	49.958
21.133	29.625	32.300	35.692	37.592	40.925	44.185	50.850
21.253	29.700	32.350	35.703	37.627	40.962	44.222	52.208
21.300	29.725	32.375	35.740	37.629	41.037	44.259	52.910
21.403	29.800	32.400	35.777	37.666	41.250	44.275	53.500
21.503	29.875	32.450	35.814	37.695	41.625	44.296	53.850
21.553	29.925	32.550	35.851	37.703	41.666	44.300	54.550
21.577	29.975	32.600	35.888	37.740	41.833	44.333	54.650
21.603	30.000	32.650	35.925	37.777	41.850	44.370	55.000
22.155	30.025	32.675	35.933	37.814	41.925	44.407	55.250
22.200	30.066	32.700	35.962	37.851	42.250	44.444	55.275
22.511	30.125	32.822	35.977	37.862	42.333	44.500	56.918
23.577	30.175	32.850	36.074	37.888	42.500	44.518	57.275
23.788	30.222	32.950	36.111	37.925	42.592	44.555	70.600
23.825	30.225	32.975	36.148	38.000	42.629	44.592	75.000
23.833	30.275	33.000	36.185	38.148	42.666	44.629	82.333
24.033	30.325	33.050	36.222	38.166	42.703	44.666	82.833
24.188	30.375	33.100	36.259	38.200	42.740	44.700	83.125
24.200	30.500	33.150	36.296	38.244	42.814	44.703	83.333
24.413	30.525	33.195	36.370	39.537	42.850	44.740	110.000
24.700	30.575	33.200	36.407	39.592	42.888	44.777	

NON-OVEN TYPE HERMETICALLY SEALED CRYSTALS MADE TO ORDER

Gold or Silver plated. Plating acts as electrodes. Spring mounted, sealed under vacuum or filled with inert gas. Max. current capacity 10 milliwatts (5 for overtone type). Very high frequency stability. Conform to military specifications. When ordering for G.E., Motorola, Link, etc. split channel operation, send sample of Xmting and Rcving crystal known to be correct and specify exact frequency desired. We will correlate and return samples with your order. All are .005% tolerance. Fundamental type supplied at 32mmfd load capacity and overtone supplied for series resonance unless otherwise specified.

15MC to 50 MC Third Overtone

$3.00 EACH

MINIATURE CRYSTALS

HC18/U

Pin Type

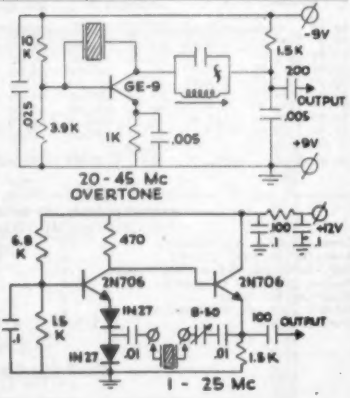
$1.55 EA.

4 for $5.00

Available in following Frequencies

MINATURE CRYSTALS WITH PINS FREQ, IN MC

3.525	4.680	12.7025
3.800	5.850	20.8000
3.980	6.305	22.3000
4.060	7.050	24.7000
4.207	7.505	29.4000
4.2585	8.476	32.3500
4.293	8.931	37.7777
4.294	9.750	57.59405
4.515	12.2475	58.2940
		103.9547
		104.2547
		104.5547
		104.7547
		104.8547
		104.9547



HOW TO ORDER...

Order your crystals by type and frequency . . . enclose check or money order (No C.O.D.) . . . add 5¢ per crystal for postage, 10¢ per crystal for airmail . . . make check or money order payable to JAN CRYSTALS, 2400 Crystal Drive, Fort Myers, Florida.

PHONE AREA 813 WE 6-2397

SEND US YOUR REQUIREMENTS . . . WE ARE RECEIVING NEW FREQUENCIES WEEKLY . . . WRITE FOR LISTINGS

JAN CRYSTALS

DIVISION OF BOB WHAN & SON ELECTRONICS, INC.

PRESSURE TYPE CRYSTALS

75c TYPE 243 EACH

3 for $2.00

Type FT-243. A most rugged type having .093 pins and .486 pin spacing (½"). Designed to operate on frequency in 32 mmfd oscillator circuit. The quartz crystal in this holder is either .5" x .5" or .5" x .6" and is held between two stainless steel electrodes by spring pressure. It is by far the most popular crystal of its type in use. Some of the government sets in which the FT-243 is used are: (Maximum drive 50 milowatts) BC620, BC659, BC611, BC1335, RT111/TRC20, R415/FRC20, R19/TRC-1, RT77/GRC9, BC1306, RT30/PRC1, AN/AMT3, BC1000, AN/PRC5, T87/TRT1, R397/TRL1 and many others.

The following frequencies are in stock for immediate delivery, frequencies guaranteed ±1 KC as listed in kilocycles.

4035	5040	5852	6450	7314	7464	7766	8290
4046	5070	5860	6473	7316	7466	7770	8291
4080	5080	5873	6475	7325	7470	7773	8300
4095	5090	5875	6497	7525	7473	7775	8306
4115	5127	5880	6500	7527	7475	7783	8308
4135	5140	5900	6506	7328	7483	7790	8310
4140	5150	5906	6516	7337	7491	7791	8316
4162	5165	5907	6520	7338	7300	7800	8320
4175	5205	5925	6525	7340	7506	7806	8325
4190	5230	5940	6528	7341	7525	7808	8330
4200	5235	5950	6540	7350	7530	7810	8333
4215	5248	5955	6550	7351	7533	7816	8333
4255	5250	5973	6573	7358	7540	7818	8541
4270	5295	5975	6575	7361	7541	7820	8350
4280	5300	5995	6600	7363	7548	7825	8358
4295	5305	6000	6606	7365	7550	7830	8360
4300	5312	6006	6618	7366	7558	7835	8366
4310	5327	6025	6625	7370	7560	7840	8370
4330	5333	6040	6630	7371	7566	7841	8375
4340	5335	6042	6640	7372	7570	7850	8380
4390	5360	6050	6645	7373	7573	7858	8383
4395	5370	6073	6650	7375	7575	7860	8390
4397	5385	6075	6660	7377	7580	7863	8391
4410	5397	6100	6663	7379	7583	7866	8400
4445	5410	6106	6673	7381	7590	7870	8403
4450	5435	6125	6675	7383	7591	7873	8408
4490	5437	6130	6690	7386	7600	7875	8410
4495	5456	6140	6700	7388	7606	7880	8416
4520	5460	6142	6706	7390	7608	7883	8420
4535	5480	6150	6708	7391	7610	7886	8425
4600	5483	6173	6725	7393	7616	7890	8430
4610	5500	6175	6733	7394	7620	7891	8433
4620	5540	6185	6740	7396	7625	7900	8440
4630	5545	6200	6750	7397	7630	7906	8441
4635	5582	6206	6773	7399	7633	7907	8450
4640	5620	6210	6775	7400	7638	7908	8458
4655	5622	6225	6790	7401	7640	7910	8466
4695	5633	6235	6798	7403	7641	7916	8470
4700	5645	6240	6800	7405	7650	7920	8475
4710	5655	6250	6806	7406	7658	7925	8480
4725	5660	6275	6813	7408	7660	7930	8483
4735	5675	6275	6825	7410	7665	7933	8490
4740	5677	6278	6826	7414	7666	7940	8491
4760	5687	6285	6831	7415	7670	7941	8700
4780	5695	6300	6833	7417	7673	7950	8710
4790	5700	6306	6835	7418	7675	7958	8716
4810	5706	6308	6837	7421	7680	7960	8720
4830	5715	6315	6840	7422	7683	7970	8725

FT-243 AMATEUR BAND CRYSTALS

UNCONDITIONALLY GUARANTEED

$1.50 EACH

4 for $5.00

40-meter general	7000 to 7300	fundamental	7000-7300
40-meter novice	7151 to 7199	fundamental	7151-7199
20-meter general	14,000 to 14,350	double	7000-7175
20-meter general	14,000 to 14,350	triple	4667-4780
15-meter general	21,000 to 21,450	triple	7000-7150
15-meter novice	21,100 to 21,250	triple	7034-7082
10-meter general	28,000 to 29,700	X4	7000-7425
6-meter gen. & tech.	50 MC to 54 MC	X6	8334-8900
2-meter general	144 MC to 148 MC	X18	8001-8221
2-meter novice	145 MC to 147 MC	X18	8056-8166
2-meter tech.	145 MC to 147 MC	X18	8056-8166

CRYSTALS IN STOCK FOR IMMEDIATE DELIVERY
LISTING IN KILOCYCLES

3525	7075	7203	8033	8120	8186	8408	8508
3735	7088	7206	8035	8125	8190	8410	8510
3800	7100	7225	8036	8126	8191	8416	8516
3825	7106	7240	8040	8128	8200	8420	8518
3830	7108	7250	8041	8130	8206	8425	8520
3840	7113	7262	8045	8133	8208	8430	8525
3885	7123	7275	8047	8140	8220	8433	8530
3920	7125	7275	8050	8141	8225	8440	
3950	7136	7278	8075	8150	8230	8445	
3970	7140	7300	8075	8155	8340	8450	
3980	7150	7306	8088	8160	8341	8458	
3990	7170	8000	8090	8164	8350	8460	
3995	7173	8006	8091	8166	8358	8470	
7006	7175	8007	8092	8170	8360	8475	
7023	7152	8008	8100	8171	8370	8480	
7025	TO	8030	8106	8173	8373	8483	
7040	7198	8020	8108	8175	8380	8485	
7050	EVERY	8021	8110	8178	8385	8491	
7068	1 KC	8023	8111	8180	8391	8499	
7073	7200	8025	8116	8183	8400	8500	

4840	5722	6320	6845	7425	7690	7973	8730
4845	5725	6325	6850	7426	7691	7975	8733
4850	5730	6330	6852	7428	7700	7980	8750
4852	5733	6335	6856	7429	7706	7983	8797
4860	5740	6340	6858	7431	7708	7990	8820
4880	5750	6350	6860	7433	7710	7991	9022
4890	5760	6362	6873	7435	7716	8240	9067
4900	5773	6373	6875	7436	7720	8241	9090
4925	5775	6375	6888	7439	7725	8250	9135
4930	5780	6388	6900	7440	7728	8258	9175
4950	5782	6400	6906	7441	7730	8260	
4960	5800	6405	6925	7444	7733	8266	
4970	5805	6406	6940	7445	7740	8270	
4980	5806	6422	6950	7448	7741	8272	
4995	5820	6425	6973	7450	7750	8273	
5000	5825	6437	6975	7455	7751	8275	
5030	5840	6440		7458	7758	8280	
5035	5850	6444	7308	7460	7760	8283	

A REAL CRYSTAL BARGAIN IN SEALED METAL HOLDERS

For experimentors and labs. These type CR7/U crystals are mounted in hermeticaly sealed cans similar to type HC6/U except can is only ½" high, pins are .050 ½" spacing — made especially for Navy type "MAR", TDZ, and RDZ sets. All crystals are fundamental frequencies and are so stamped on side of can.
All frequencies listed are in stock for immediate delivery. * denotes frequencies we have in quantities of 50 or more each.
Every crystal tested and guaranteed to .01% tolerance.

Special price type CR7/U

75¢

3 for 2.00

Order by frequency and specify 2nd choice if possible.

4285.19	5202.08	*5614.82	5900.00	6239.06	6618.75	*7051.85
4329.63	5203.70	*5629.63	5901.56	6251.56	6625.93	*7052.08
4344.44	*5214.82	5633.33	5902.08	*6251.85	6637.04	*7070.37
4374.07	5235.42	5635.42	5914.06	6252.08	6640.74	*7081.48
4403.70	*5248.19	5639.06	*5925.93	6255.56	*6652.08	*7085.42
4500.00	*5259.26	*5644.44	5926.95	6264.06	6655.56	7096.30
4625.93	5268.75	5651.56	5929.63	6268.75	*6666.67	7100.00
4640.74	5277.78	5652.08	5935.42	6276.56	*6668.75	7114.82
*4655.55	*5288.89	*5659.26	5951.56	*6281.48	*6681.48	*7125.93
4700.00	5292.59	5662.96	5952.08	6285.19	*6685.42	*7140.74
4727.63	*5303.70	5685.42	*5955.56	6289.06	6700.00	7144.44
4729.63	*5333.33	*5688.89	5968.75	*6311.11	*6714.81	*7155.56
*4774.07	*5339.06	5692.52	5976.56	6314.82	*6718.75	7159.26
4774.40	*5348.15	5701.56	5988.89	6326.56	*6725.93	7170.37
4788.89	*5364.06	5702.08	5989.06	*6340.74	6729.63	*7185.19
4844.44	*5366.67	*5703.70	6002.06	*6344.44	6744.44	*7200.00
4862.96	5377.00	5714.06	6014.06	6352.08	*6752.08	*7214.82
4877.78	*5389.06	5722.22	6018.75	*6370.37	6755.56	7218.52
4888.88	*5401.56	*5733.33	*6026.56	*6374.07	6774.07	*7244.44
4892.00	*5422.22	5739.06	6035.42	6377.08	*6785.16	*7259.26
*4903.70	*5437.04	5748.15	*6039.06	6385.42	*6785.42	*7274.07
4907.06	*5439.06	5751.56	6048.15	6400.00	6803.70	*7288.88
4922.22	*5451.85	5776.56	6052.08	6403.70	6814.82	*7303.70
*4933.33	5464.06	5781.48	*6076.56	6418.52	6818.52	*7333.33
*4951.85	*5466.67	5785.42	6077.76	*6429.63	*6818.75	7362.96
*4962.96	*5481.48	*5789.06	6085.42	*6459.26	*6844.44	*7377.78
4966.66	5489.06	5801.56	6102.08	6462.96	6848.15	*7407.41
*4996.30	*5511.11	5802.08	*6103.70	6477.78	*6852.08	*7422.22
5011.11	5514.80	5807.41	6107.41	*6488.89	6862.96	
5025.93	5518.93	5811.11	6122.22	6492.59	*6874.07	7437.04
5055.56	*5525.93	*5814.06	*6133.33	*6785.16	6877.78	*7481.48
5070.37	5535.42	5818.00	6135.06	*6518.52	*6885.42	*7629.63
5085.19	5539.06	*5826.56	6152.42	6522.22	*6903.70	7659.26
5100.00	5544.44	5835.42	*6162.96	6537.04	*6918.75	*7662.96
5102.08	5552.08	5837.04	6166.67	*6548.15	*6922.22	*7674.07
5129.63	*5555.56	5839.06	*6192.59	6552.08	6933.33	*7688.89
5135.42	5564.06	*5840.74	6196.30	6566.67	*6952.08	*7703.70
5144.44	5570.37	*5851.56	*6201.56	*6577.78	*6962.96	*7718.51
5174.07	5574.00	5852.03	*6207.41	6581.48	*6977.78	*7733.33
*5185.18	5589.06	5870.37	6218.75	6585.42	*6985.42	*7777.78
5185.42	*5589.19	5876.56	*6222.22	6596.30	*7018.75	
5188.89	5602.08	5885.42	6225.93	*6607.41	*7022.22	
*5200.00	5603.70	*5889.06	*6226.56	6611.11	*7037.04	

HOW TO ORDER...

ADD 5¢ PER CRYSTAL FOR POSTAGE OR 10¢ PER CRYSTAL FOR AIRMAIL

Order your crystals by type and frequency . . . enclose check or money order (No C.O.D.) . . . add 5¢ per crystal for postage, 10¢ per crystal for airmail . . . make check or money order payable to JAN CRYSTALS, 2400 Crystal Drive, Fort Myers, Florida.

PHONE AREA 813 WE 6-2397

JAN CRYSTALS

LOW FREQUENCY CRYSTALS in HC6/U HOLDERS

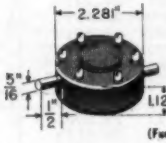
ORDER BY FREQUENCY

For Lattice Networks—Single Sideband—
Low Frequency Oscillators—Markers—
Etc. Frequency is fundamental in KC.

371 to 540KC 3.95

730 to 1000KC 3.55

CRYSTAL TYPE FT-164



This rugged type crystal was designed for the U. S. Navy and uses a 1" x 1" AT blank. We can furnish in frequencies from 200KC to 7000KC.

(Fundamental Frequency .005% tolerance)

ORDER BY FREQUENCY — 1601KC to 7000KC ..... 7.50 ea.

TYPE FT249 HOLDER

(Pin Spacing Standard — Diameter .125)

CRYSTALS

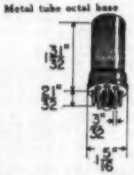
Made to Order

This 3 pin Holder can be supplied with either one or two crystals. When ordering specify if crystal is to be used for Transmitter or Receiver or Both.

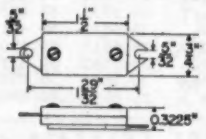
FT249 with Single Crystal	FT249 with Duo Crystals
2001KC to 8000KC 3.50 ea.	2001KC to 8000KC 6.50 ea.

MARKER — FILTER SPECIAL USE CRYSTALS

3579.545 KC T.V. Color Burst HC6/U WIRE LEADS 2.50



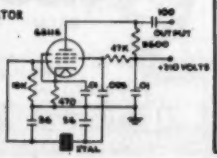
3500	KC Marker in metal tube octal base used in ARC/5 1.50
4000	KC Marker in metal tube octal base used in ARC/5 1.50
6300	KC Marker in metal tube octal base used in ARC/5 1.50
8000	KC Marker in metal tube octal base used in ARC/5 1.50



DC-6-A

470 KC Filter Crystal DC6A for BC342 & BC312 ..... 1.50

FUNDAMENTAL CRYSTAL OSCILLATOR CIRCUIT FREQUENCIES 800KC TO 20,000KC



B - voltage may vary from 100 volts for HC6/U crystals to 250 volts for FT243 and MC7 crystals or other pressure mounted types.

PRESSURE-TYPE CRYSTALS

Made to Order

TYPE 243

$2.00 EACH

All Crystals .003% tolerance

Available in all frequencies from 2000KC to 8650KC

MC7 CRYSTALS

$2.00 EACH

⅛" pins, ¾" pin spacing, available in 2182, 2638, 2003, 4755 KC and all marine frequencies.

FT-171

For BC-610, etc.

$2.00 EACH

Available in all frequencies from 2000KC to 5000KC.

CR1A/AR

Pressure type crystal used in SCR-522, etc.

$2.00 EACH

All frequencies from 4000KC to 8650KC available with ½" pin spacing and ⅛" pin diam. Specify frequency desired.

THIRD OVERTONE
TYPE FT 243

IN STOCK FREQ.
IN MC

$2.00 EACH

14.310	15.953	16.913
14.420	16.000	16.953
14.580	16.040	16.973
14.593	16.080	17.0933
14.687	16.133	17.150
14.800	16.240	17.173
14.833	16.4933	17.295
15.200	16.533	17.413
15.353	16.573	17.600
15.753	16.5933	17.750
15.840	16.800	

CR24/U (BARREL TYPE) CRYSTALS

CR24/U

Designed for the Armed Services the CR24/U is a Pressure Type "AT" Crystal which will accommodate more current than the plated crystal. From 15 to 25MC the crystal is a third overtone—From 25.001 to 60MC the crystal is a fifth overtone.

$2.00 EACH

FREQ. MC	
	19.8250
	19.8500
16.505	19.8900
18.400	19.8917
19.0583	20.0000
19.2833	20.0666
19.2917	20.1167
19.4833	20.2500
19.4917	20.3700
19.4917	20.6000
19.5500	20.6700
19.5583	20.8167
19.6500	20.8250
19.6833	20.8333
19.6916	20.8833
19.8167	20.8917

CRYSTALS IN STOCK FOR IMMEDIATE DELIVERY

20.9500	22.2833	23.3417	24.1800	26.2833	28.8250	30.6925
20.9583	22.2900	23.3500	24.1833	26.2917	28.8750	30.7000
21.0300	22.2917	23.3583	24.2833	26.4167	28.8833	30.8167
21.0333	22.3583	23.3833	24.2917	26.4250	28.8917	30.8250
21.1000	22.3500	23.3917	24.3000	26.5500	28.9333	30.8833
21.1500	22.4333	23.4300	24.3500	26.5583	29.0833	30.8917
21.1583	22.4833	23.4333	24.5166	26.6000	29.0917	30.9500
21.2666	22.4917	23.5166	24.5333	26.6200	29.1500	30.9583
21.2833	22.5000	23.5200	24.5583	26.6833	29.1583	30.9666
21.2916	22.5500	23.5500	24.7416	26.6917	29.2167	31.1000
21.3500	22.5583	23.5583	24.7500	26.8167	29.2250	31.1500
21.3583	22.6167	23.5667	24.7800	26.8250	29.3000	31.1583
21.3667	22.6250	23.5800	24.8400	26.8667	29.3500	31.6250
21.3833	22.6500	23.6167	24.9333	26.9500	29.3583	31.6333
21.4166	22.7000	23.62500	24.9166	26.9583	29.4167	31.8166
21.4833	22.7500	23.6700	24.9333	26.9800	29.4250	31.8250
21.4417	22.7583	23.7000	24.9500	26.9666	29.5500	31.9500
21.4917	22.7700	23.7500	24.9583	27.0833	29.5583	31.9583
21.5500	22.8000	23.7583	24.9833	27.0917	29.6173	32.0166
21.5583	22.8166	23.7600	25.0416	27.1000	29.6250	32.0250
21.8500	22.8250	23.7666	25.0833	27.1667	29.6666	32.0370
21.8833	22.8300	23.7700	25.0917	27.2250	29.6833	32.0833
21.8917	22.8833	23.7666	25.1167	27.3375	29.6971	32.0917
21.9500	22.8917	23.7900	25.1500	27.3500	29.7500	32.1500
21.9583	22.9500	23.8167	25.1917	27.3583	29.7583	32.1583
22.0166	22.9583	23.8800	25.2167	27.4600	29.8167	32.2166
22.0250	23.0400	23.9000	25.2250	27.4833	29.8250	32.2250
22.0500	23.0833	24.0000	25.3000	27.4917	29.8333	32.2833
22.0833	23.0917	24.1000	25.3200	27.5500	29.8833	32.2917
22.0916	23.1300	24.1166	25.3583	27.5583	29.8971	32,4833
22.1100	23.1500	24.1200	25.3500	27.6375	29.9500	32.4917
22.1500	23.1583	24.1500	25.3583	27.7500	29.9583	32.5833
22.1583	23.2833	24.1583	25.3667	27.7583	29.9666	33.0375
22.2000	23.2917	24.1600	25.3900	27.8833	30.0833	33.2500
			25.4167	27.8917	30.0916	33.5000
			25.4250	28.0000	30.1500	33.5667
			25.4833	28.0166	30.1583	33.8375
			25.4917	28.0250	30.2167	34.0500
			25.6167	28.1500	30.2250	34.2875
			25.6250	28.1583	30.2833	34.4666
			25.7000	28.2833	30.2917	34.5083
			25.7500	28.2917	30.3375	34.7500
			25.7583	28.3833	30.3500	36.9375
			25.8250	28.4167	30.3583	37.9375
			25.8833	28.4250	30.3750	40.1375
			25.8917	28.5500	30.4375	40.5375
			26.0167	28.5583	30.4833	41.7666
			26.0200	28.6833	30.4917	43.0566
			26.0250	28.6917	30.6167	60.9617
			26.1500	28.7583	30.6250	
			26.1583	28.7666	30.6833	
			26.2300	28.8166	30.6917	

CITIZEN BAND CRYSTALS

MINIATURE CRYSTALS WITH PINS FOR TRANS. AND RECEIVING FREQUENCIES LISTED ARE IN STOCK. ORDER BY FREQUENCY.

CHANNEL	TRANSMIT	REC +455IF	REC +1680IF
1	26965	27430	28645
2	26975		
3	26985		
4		27440	
5	27015		
6	27025		
7	27035	27490	28715
8	27055		28735
9	27065	27520	
10	27075		28755
11	27085	27540	28765
12	27105		28785
13	27115		
14	27125		
15	27135	27590	
16	27155	27610	28835
17	27165	27620	28845
18	27175		
19	27185		28865
20	27205	27660	
21	27215	27670	28895
22	27225		

$1.75 EACH OR 3 CRYSTALS for $5.00

THE FREQUENCIES LISTED ARE FOR CADRE MODELS C-60, C-75, C-100, C-500, C-501, C-510, C-515. SINGLE CRYSTALS $ 1.75 EA. OR THREE FOR $ 5.00. MATCHED PAIRS TRAN. AND RECEIVE $3.00 PER PAIR OR FOUR PAIRS FOR $10.00. THESE CRYSTALS ARE NEW AND WERE MANUFACTURED FOR CADRE CB SETS.

★

QUALITY CRYSTALS

For Every Purpose

SPECIAL CRYSTALS IN STOCK

$3.50 EACH

1000 KC FREQ. STANDARD IN HC6/U HOLDER NEW MANUFACTURE

$4.50 EACH

100 KC FREQUENCY STANDARD HC13/U HOLDER NEW MANUFACTURE

$1.50 EA.

4 for $5.00

The CR18/U is a hermetically sealed plated crystal fundamental frequency to be used in parallel oscillator circuit of 32 mmfd. Tolerance is .005% from −55° to +90° Centigrade. It may be used to double, triple, or quadruple, to any desired frequency. Maximum drive is 10 milowatts.

CRYSTALS LISTED ARE FUNDAMENTAL FREQUENCIES. WE WILL MAKE TO ORDER ANY FREQUENCY FROM 2000KC TO 12000KC IN HC6/U HOLDER .005% TOLERANCE AT

$2.55 EACH

BE SURE TO SPECIFY EXACT FREQUENCY AND CIRCUIT IT IS TO BE USED IN TO INSURE CORRECT CORRELATION.

DELIVERY ON SPECIAL FREQUENCIES CAN BE MADE IN 48 HOURS AFTER RECEIPT OF ORDER.

FUNDAMENTAL FREQUENCY

HERMETICALLY SEALED CRYSTALS

in HC6/U HOLDERS

ORDER BY FREQUENCY

FREQUENCIES LISTED ARE IN KILOCYCLES

1400	2382	2855	3768	6258	6753	7375	8199	8786	11877
1753	2388	2868	3775	6261	6758	7383	8200	8791	12358
1763	2391	2877	3777	6298	6761	7385	8215	8887	12365
1843	2394	2887	3805	6316	6765	7390	8216	8950	12366
1845	2418	2900	3814	6332		7400	8221	9044	12373
1848	2436	2910	3851	6343	6776	7415	8223	9045	12379
1849	2437	2931	3870	6354	6805	7428	8228	9050	12380
1925	2442	2945	3900	6365	6850	7435	8233	9088	12383
1927	2449	2957	4200	6366	6872	7450	8236	9108	12397
1932	2453	2966	4280	6376	6877	7458	8240	9150	12400
1937	2460	2971	4835	6487	6883	7473	8242	9322	12403
1939	2467	2980	4843	6398	6888	7515	8246	9327	12405
1945	2494	2987	4854	6400	6894	7516	8248	9337	12412
1994	2561	2998	4860	6404	6900	7537	8250	9397	12441
2052	2594	3000	4889	6410	6905	7548	8253	9412	12564
2055	2617	3008	4910	6411	6922	7561	8258	9500	12568
2072	2618	3023	4993	6415	6925	7575	8261	9537	12573
2075	2622	3060	5108	6421	6927	7585	8268		12575
2085	2625	3067	5131	6425	6933	7591	8273		12579
2090	2628	3105	5147	6432	6938	7600	8285	9579	12580
2096	2632	3127	5156	6443	6940	7638	8292	9604	12597
2101	2647	3139	5157	6450	6944	7651	8294	9636	12600
2110	2650	3142	5171	6455	6950	7660	8296	9637	12604
2126	2654	3144	5205	6470	6955	7665	8300	9683	12625
2135	2658	3151	5275	6476	6961	7683	8302	9697	12629
2144	2667	3154	5335	6487	6966	7715	8307	9750	12716
2146	2674	3156	5416	6500	6972	7740	8317	9777	12718
2148	2677	3163	5421	6510	6977	7750	8320	9787	12793
2150	2681	3166	5437	6516	6983	7758	8338	9794	13012
2151	2684	3181	5555	6528	6986	7775	8340	9888	13016
2155	2688	3199	5569	6550	6988	7822	8347	10125	13023
2161	2694	3203	5580	6555	6994	7833	8350	10131	13037
2163	2695	3207	5610	6559	7005	7838	8353	10195	13272
2165	2699	3211	5632	6566	7010	7850	8376	10300	13320
2169	2710	3216	5730	6572	7011	7867	8380	10367	13376
2172	2715	3231	6043	6577	7016	7886	8385	10515	13485
2174	2716	3233	6060	6583	7022	7894	8392	10626	13655
2176	2726	3236	6071	6589	7027	7925	8407	11111	13817
2179	2730	3238	6091	6591	7038	8016	8415	11175	13910
2185	2732	3240	6093	6605	7061	8021	8419	11400	13985
2194	2737	3242	6098	6611	7083	8035	8435	11490	14316
2198	2744	3248	6104	6616	7091	8040	8450	11250	14777
2202	2751	3251	6109	6618	7100	8050	8452	11356	14818
2208	2757	3255	6130	6626	7105	8091	8469	11381	15318
2209	2760	3261	6132	6627	7111	8114	8471	11390	15680
2214	2762	3263	6137	6638	7120	8140	8488	11478	19683
2215	2767	3268	6142	6641	7122	8142	8541	11496	19850
2217	2773	3276	6148	6650	7150	8146	8547	11500	
2219	2782	3327	6152	6655	7172	8148	8550	11518	
2226	2788	3400	6159	6671	7250	8152	8572	11526	
2237	2794	3432	6164	6683	7256	8160	8584	11540	
2240	2805	3450	6181	6694	7258	8164	8625	11557	
2253	2810	3566	6183	6705	7270	8167	8637	11562	
2275	2813	3579	6187	6708	7277	8169	8650	11651	
2293	2817	3650	6193	6716	7278	8171	8666	11657	
2320	2820	3683	6198	6727	7305	8176	8686	11696	
2344	2835	3691	6203	6733	7338	8183	8750	11707	
2362	2840	3742	6243	6738	7345	8185	8775	11835	
2375	2854	3759	6248	6750	7350	8192	8783	11861	

JAN CRYSTALS

PHONE AREA 813 WE 6-2397

ADD 5¢ PER CRYSTAL FOR POSTAGE OR 10¢ PER CRYSTAL FOR AIRMAIL

SEND US YOUR REQUIREMENTS . . . WE ARE RECEIVING NEW FREQUENCIES WEEKLY . . . WRITE FOR LISTINGS

2400 CRYSTAL DRIVE • FORT MYERS, FLORIDA 33901

LOW FREQUENCY TYPE CRYSTALS

HC-6/U CRYSTALS FIT STD. OCTAL SOCKET
HC-6/U PIN SPACING .486 PIN DIA. .093

370KC to 540KC in FT241 Holders

FT 241

FOR LATTICE NETWORKS — SINGLE SIDE BAND — LOW FREQUENCY OSCILLATORS — MARKERS — ETC. All crystals listed are fundamental frequencies in Kilocycles. Channels 0 to 79 and channels 270 to 289 comprise sets of 80 and 120 crystals.

75c EACH
3 for $2.00

ADD 5¢ EA. CRYSTAL FOR HANDLING
10c FOR AIR MAIL

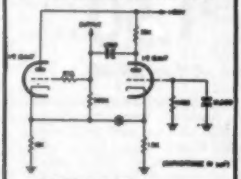
ORDER BY CHANNEL NUMBER AND FREQUENCY

NOMINAL CRYSTAL FREQ. KC	CHANNEL NO.	NOMINAL CRYSTAL FREQ. KC	CHANNEL NO.	NOMINAL CRYSTAL FREQ. KC	CHANNEL NO.	NOMINAL CRYSTAL FREQ. KC	CHANNEL NO.	NOMINAL CRYSTAL FREQ. KC	CHANNEL NO.
370.370	0	386.811	267	424.074	39	480.000	234	477.778	68
372.222	1	400.000	10	425.000	206	451.388	235	479.166	245
374.074	2	400.000	268	426.528	20	451.865	44	479.630	80
375.000	270	401.388	269	430.386	209	453.777	236	480.555	246
375.926	3	401.852	17	427.777	288	453.704	45	481.481	69
378.388	271	402.777	290	427.778	21	454.166	289	481.944	247
377.777	272	403.704	18	429.166	289	454.944	290	483.333	61
377.778	4	404.166	291	429.630	22	457.407	47	483.333	248
378.188	273	405.555	292	430.555	210	458.333	830	484.722	249
379.629	5	405.556	19	431.481	23	458.389	48	488.188	62
380.555	274	406.944	293	431.944	211	459.722	331	488.111	250
381.481	6	407.407	20	433.333	24	461.111	49	487.037	63
381.944	275	408.333	294	433.333	212	461.111	332	487.500	251
383.333	7	409.259	21	434.722	213	462.500	333	488.888	252
383.333	276	409.722	295	435.087	25	462.963	50	488.889	64
384.722	277	411.111	22	436.111	214	465.388	334	488.377	253
385.188	8	411.111	296	437.037	26	464.815	51	490.741	65
388.111	278	412.500	297	437.500	215	465.277	335	491.666	254
387.037	9	413.963	23	438.888	216	466.666	336	492.592	66
387.500	279	413.888	298	438.889	27	466.667	52	493.055	255
388.888	280	414.815	24	440.277	217	468.055	337	494.444	67
388.889	10	415.277	299	440.741	28	469.810	53	494.444	256
390.277	281	416.666	300	441.666	218	469.444	338	495.833	257
390.741	11	418.487	25	442.593	29	470.370	54	496.296	68
391.666	282	418.055	301	443.055	219	470.833	339	497.225	258
392.593	12	418.519	26	444.444	40	472.222	55	498.148	69
393.055	283	419.444	302	444.444	220	472.222	340	498.611	259
394.444	13	420.370	27	445.833	221	473.611	341	501.388	261
394.444	284			446.296	41	474.074	56	501.852	71
395.833	285	420.833	303	447.222	222	475.000	342	502.777	262
396.292	14	422.222	28	448.148	42	475.926	57	503.704	72
397.222	286	422.222	304	448.811	223	476.388	343	504.166	263
398.148	15	423.611	305	450.000	43	477.777	344	505.555	264

455	KC	FT241 Holder .05% tol.	1.00
500	KC	FT241 Holder .05% tol.	1.00

ANY FREQUENCY FROM 370KC TO 541KC PLUS OR MINUS 5 CYCLES. SPECIFY EXACT FREQUENCY $1.75 each POST PAID

LOW FREQUENCY OSCILLATOR



80 TO 800 KC

★

QUALITY CRYSTALS
For Every Purpose
In Stock For
Immediate Delivery
24-HOUR SERVICE

FT241 LOW FREQUENCY CRYSTALS FROM 729 KC TO 1040 KC
ORDER BY CHANNEL NUMBER

Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.	Channel	Crystal Freq. KC.
70.0	729.167	72.4	764.583	76.8	800.000	80.2	835.417	83.6	868.750	86.6	902.083	89.9	936.458	93.3	971.875	96.8	1008.333
70.1	730.208	72.5	765.625	76.9	801.042	80.3	836.458	83.5	869.792	86.7	903.125	90.0	937.500	93.4	972.917	96.9	1009.375
70.2	731.250	72.6	766.667	77.0	802.083	80.4	837.500	83.6	870.833	86.8	904.167	90.1	938.542	93.5	973.958	97.0	1010.417
70.3	732.292	72.7	767.708	77.1	803.125	80.5	838.542	83.7	871.875	86.9	905.208	90.2	939.583	93.6	975.000	97.1	1011.458
70.4	733.333	72.8	768.750	77.2	804.167	80.6	839.583	83.8	872.917	87.0	906.250	90.3	940.625	93.7	976.042	97.2	1012.500
70.5	734.375	72.9	769.792	77.3	805.208	80.7	840.625	83.9	873.958	87.1	907.292	90.4	941.667	93.8	977.083	97.3	1013.542
70.6	735.417	74.0	770.833	77.4	806.250	80.8	841.667	84.0	875.000	87.2	908.333	90.5	942.708	93.9	978.125	97.4	1014.583
70.7	736.458	74.1	771.875	77.5	807.292	80.9	842.708	84.1	876.042	87.3	909.375	90.6	943.750	94.0	979.167	97.5	1015.625
70.8	737.500	74.2	772.917	77.6	808.333	81.0	843.750	84.2	877.083	87.4	910.417	90.7	944.792	94.1	980.208	97.6	1016.667
70.9	738.542	74.3	773.958	77.7	809.375	81.1	844.792	84.3	878.125	87.5	911.458	90.8	945.833	94.2	981.250	97.7	1017.708
71.0	739.583	74.4	775.000	77.8	810.417	81.2	845.833	84.4	879.167	87.6	912.500	90.9	946.875	94.3	982.292	97.8	1018.750
71.1	740.625	74.5	776.042	77.9	811.458	81.3	846.875	84.5	880.208	87.7	913.542	91.0	947.917	94.4	983.333	97.9	1019.792
71.2	741.667	74.6	777.083	78.0	812.500	81.4	847.917	84.6	881.250	87.8	914.583	91.1	948.958	94.5	984.375	98.0	1020.833
71.3	742.708	74.7	778.125	78.1	813.542	81.5	848.958	84.8	883.333	88.0	916.667	91.2	950.000	94.6	985.417	98.1	1021.875
71.4	743.750	74.8	779.167	78.2	814.583	81.6	850.000	84.9	884.375	88.1	917.708	91.3	951.042	94.7	986.458	98.2	1022.917
71.5	744.792	74.9	780.208	78.3	815.625	81.7	851.042	85.0	885.417	88.2	918.750	91.4	952.083	94.8	987.500	98.3	1023.958
71.6	745.833	75.0	781.250	78.4	816.667	81.8	852.083	85.1	886.458	88.3	919.792	91.5	953.125	94.9	988.542	98.4	1025.000
71.7	746.875	75.1	782.292	78.5	817.708	81.9	853.125	85.2	887.500	88.4	920.833	91.6	954.167	95.0	989.583	98.5	1026.042
71.8	747.917	75.2	783.333	78.6	818.750	82.0	854.167	85.3	888.542	88.5	921.875	91.7	955.208	95.1	990.625	98.6	1027.083
71.9	748.958	75.3	784.375	78.7	819.792	82.1	855.208	85.4	889.583	88.6	922.917	91.8	956.250	95.2	991.667	98.7	1028.125
72.0	750.000	75.4	785.417	78.8	820.833	82.2	856.250	85.5	890.625	88.7	923.958	92.1	959.375	95.5	994.792	99.0	1031.250
72.1	751.042	75.5	786.458	78.9	821.875	82.3	857.292	85.6	891.667	88.9	926.042	92.3	961.458	95.7	996.875	99.2	1033.333
72.2	752.083	75.6	787.500	79.0	822.917	82.4	858.333	85.7	892.708	89.0	927.083	92.4	962.500	95.8	997.917	99.3	1034.375
72.3	753.125	75.7	788.542	79.1	823.958	82.5	859.375	85.8	893.750	89.1	928.125	92.5	963.542	95.9	998.958	99.4	1035.417
72.4	754.167	75.8	789.583	79.2	825.000	82.6	860.417	85.9	894.792	89.2	929.167	92.6	964.583	96.0	1000.000	99.5	1036.458
72.5	755.208	75.9	790.625	79.3	826.042	82.7	861.458	86.0	895.833	89.3	930.208	92.7	965.625	96.2	1002.083	99.6	1037.500
72.6	756.250	76.0	791.667	79.4	827.083	82.8	862.500	86.1	896.875	89.4	931.250	92.8	966.667	96.3	1003.125	99.7	1038.542
72.7	757.292	76.1	792.708	79.5	828.125	82.9	863.542	86.2	897.917	89.5	932.292	92.9	967.708	96.4	1004.167	99.8	1039.583
72.8	758.333	76.2	793.750	79.6	829.167	83.0	864.583	86.3	898.958	89.6	933.333	93.0	968.750	96.5	1005.208	99.9	1040.625
72.9	759.375	76.3	794.792	79.7	830.208	83.1	865.625	86.3	898.958	89.6	933.333	93.0	968.750	96.5	1005.208	99.9	1040.625
73.0	760.417	76.4	795.833	79.8	831.250	83.2	866.667	86.4	900.000	89.7	934.375	93.1	969.792	96.6	1006.250		
73.1	761.458	76.5	796.875	79.9	832.292	83.3	867.708	86.5	901.042	89.8	935.417	93.2	970.833	96.7	1007.292		
73.2	762.500	76.6	797.917	80.0	833.333												
73.3	763.542	76.7	798.958	80.1	834.375												

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General Radio 1001A	Like new	600.00
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TS-419/U 900-2100Mc	Excellent	350.00
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TS-186/U 100-10,000 Mc	Excellent	200.00
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TN-18/APR-4 300-1000	Excellent	49.95
TN-19/APR-4 975-2200 Mc.	Excellent	59.95

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TO-85 flat pack guaranteed to work. They come complete schematic, elect characteristic sheet & some typical applications. $9.00—$15.00 value from original manufacturer. We have other types of IC's in these categories available, send requests.

Silicon Controlled Rectifiers

PRV	7A	20A
50	.50	.80
100	.70	1.35
200	1.05	1.90
300	1.60	2.45
400	2.10	2.85
500	2.80	3.50
600	3.20	
700	3.50	
800	4.00	
900	4.50	
1000	5.00	

PRV	1A	350 MA
30		.30
60	.70	.50
100	.90	.70
200	1.10	.90
300	1.25	1.00

Top Hats and Epoxies 750 MA

PRV	
100	.07
200	.09
400	.12
600	.20
800	.25
1000	.50
1200	.65
1400	.85
1600	1.00
1800	1.15

1.25A. Glass Amp. Diode

PRV	
100	.12
200	.17
400	.25
600	.40
800	.50
1000	.65

A controlled avalanche rectifier in which the rated PRV may be exceeded without the rectifier breaking down.

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PRV	3A	20A	40A	240A
100	.10	.40	1.00	5.00
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600	.35	1.20	2.50	20.00
800	.45	1.50	3.00	
1000	.65		4.00	35.00

OUR TRANSISTORS AND RECTIFIERS ARE GUARANTEED TO WORK

All transistors are checked for minimum voltage and gain, insuring our customers a good transistor within the category we advertise. All rectifiers costing over 10c are checekd for forward voltage and leakage, as well as PRV. The gates on our SCR's are also checked. All non-operable units will be refunded or exchanged immediately. We stand on our reputation for quality products and service.

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TRANSISTORS

A) Similar to 2N2185 (PNP). A silicon epitaxial low leakage transistor in TO-18 package, to 30 volts at 150 mw. **3/$1.00**

B) Similar to 2N329A (PNP). A general purpose silicon epitaxial transistor in a TO-5 package, low leakage, to 30 volts and β of 30-80. Compare with $9.00 value. **3/$1.00**

C) Similar to 2N3060 (PNP). A 60 volt silicon transistor in a TO-46 pack with a β of 30 at .4 w dissipation. These transistors are used in DC amplifiers, audio systems and in high voltage work. **3/$1.00**

D) Similar to 2N1640 (PNP). A bi-directional transistor in which the emitter and collector are interchangeable. This is a silicon unit in a TO-5 package. **$.75 ea.**

E) Similar to 2N339-2N341 (NPN) etc. A high voltage, medium power (5 watts) silicon (NPN) transistor. **5/$1.00**

F) Similar to 2N547A, B and C, etc. A silicon transistor in a TO-5 package mounted in its own heat sink. **3/$1.00**

G) Similar to 2N728 (NPN). A high frequency silicon unit in a TO-18 package extending to the UHF range. **3/$1.00**

H) Similar to 2N995 (PNP) silicon unit with 1.2 w dissipation in a TO-18 package. This transistor has cut-off frequencies to 180 mc. **3/$1.00**

I) Similar to 2N699 (NPN). A 5 watt silicon, high voltage transistor in a TO-5 package used for fast switching. Ultra high frequency. **3/$1.00**

J) Similar to 2N2875 (PNP) silicon 20 watt power transistor with a cut-off frequency to 30 mc. **$.75**

K) Similar to 2N1648 (NPN) silicon high voltage, 20 watt unit used in output stages and power transistor drivers. **$.75**

L) Similar to 2N2885 (NPN) and TMT-8035 (PNP) microtransistors, they are high frequency transistors which dissipate 75 mw. of power **Both units $1.00**

N) Similar to 2N155 (PNP), a 20 watt germanium power transistor in a TO-3 package used in audio work. **4/$1.00**

O) Similar to 2N327A (PNP) silicon transistor in a TO-5 package used in audio work. **4/$1.00**

P) Similar to 2N519 (PNP), a TO-5 germanium transistor used in RF circuits. **6/$1.00**

Q) Similar to 2N389, 424 (NPN) etc., an 85 watt, 60-100 volt transistor with many high voltage power applications. **$.75 ea.**

R) Similar to 2N1209, 2N1212, etc. These transistors have the same electrical characteristics as the 2N389's, but are stud mounted. **$.75**

T) Similar to 2N497 (NPN), a silicon transistor in a TO-5 package for general purpose use. **5/$1.00**

S) FET's, N channel type similar to C610 used in amplifiers, switches, and choppers—very high input impedance. **$1.50**

U) NPN dual transistors. A TO-5 package (2N2060) which contains 2 NPN silicon transistors. **$1.50**

V) PNP dual transistors. This package (2N2807) contains 2 PNP transistors in a TO-5 can. **$1.50**

W) Similar to 2N117 (NPN), a silicon transistor, used as a small signal transistor in a flat package. **4/$1.00**

X) Similar to 2N1131 (PNP) silicon TO-5 transistor used for VHF, oscillator, audio and DC work. **3/$1.00**

Y) High Voltage 150V VBCBO at 2.5A High HFE in TO-66 Pack **$.75**

Z) High Voltage 200V VBCBO at 2.5A High Gain in TO-66 Pack **$1.00**

RECTIFIERS

A) 10 watt ZENERS. 2-180 volts. STATE DESIRED VOLTAGES. **$.75 ea.**

B) COLOR CODED GLASS DIODES. Si. **20/$1.00** Ge. **30/$1.00**

C) Similar to 1N251, a high frequency diode used to 1000 Mc. PIV. of 20 volts. **10/$1.00**

D) Similar to S284. A 30 PIV unit with characteristics similar to 1N251. **10/$1.00**

E) Silicon bilateral switch. Replaces SCR's by firing in either direction when the breakover voltage is exceeded. It is used as a light dimmer, etc. with schematic. **$.75**

F) 1N429. A 6 VOLT DOUBLE ANODE REGULATOR, 2 WATTS **5/$1.00**

G) SV176. A 7 VOLT REFERENCE DIODE, 2 WATTS. **5/$1.00**

H) High Voltage Assemblies. 6000V at 200 mils. These Silicon Assemblies may be put in Series to Achieve Higher Voltages. **$1.50**

I) Microdiodes, similar to MD27, etc., up to 200 PIV at 100 μ a. These are switching diodes with a short recovery time. The size of the body is only .05" in diameter. **6/$1.00**

J) GA AS VARACTORS, SIMILAR TO AP-1, AP-6, etc. 70 KMC at 160 mw. **$4.00 ea.**

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POST OFFICE BOX 74
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RECEIVERS - TRANSMITTERS

ARR-15—Collins receiver, manual or auto tune, covers 1.5 to 18 MHz, has built in crystal calibrator also permeability tuned oscillator $49.50

APR-4 Receiver—11 tube superhet, uses tuning units to cover 38-4000 MHz. Receiver less tuning units $59.50

AMT-4 Weather balloon transmitters, compact and light, new $3.95

ART-13 Transmitter—100-watt with 813 final, 2 to 18 MHz $29.50

ARC-1 Transceiver—100-156 MHz, uses 832A in final $29.50

BC-1000 Transceiver—18 tube portable, 2-way radio, 40-48 MHz, can be used on 6 meters, less tubes $29.50
with tubes $39.50

ARR-26—FM receiver, 152-174 MHz not mounted in case. Some with tubes, Has 30-MHz IF strip. Will make good 2-meter receiver. In as is condition $4.95

URC-19—Mobile FM in two bands, 25 to 50 MHz and 152 to 174 MHz. Good for 6 and 2 meters. Comes in 3 separate units: transmitter, receiver and power supply. Beautifully constructed and delivers 30 watts. Can be converted to A.M. $49.50

TSC Receiver & Transmitter Set—Includes TSC remote control, 12 VDC power supply and antenna loading coil. Covers 1500 to 12,000 MHz. All for $149.50

TUBES

3C22—new boxed. **$2.95 each or 2 for $5.00**

100TH—new boxed, each $4.95

1625—new boxed ..... 3/$1.49

807 ..... each 97c

707B—1200 MHz klystron ..... 3/$1.00

717A—Direct replacement for 6SK7, 6SH7, 6SJ7, 6AK7, 6SG7, also used for octal 6AK5. Good for reduction in noise level, and IF gain ..... 10/$2.95

Bulk Packed—

5814—Same as 12AU7 ..... 5/$1.00

6J6 ..... 3/$1.00

6H6 ..... 3/$1.00

6AC7 ..... 3/$1.00

902A—Scope tube 2" with octal base new, each $2.95

1P28 Photo multiplier tube, each $3.95

TEST EQUIPMENT

URM-26—Navy version of Model 80 or TS-497. More compact and later style. Covers 2-400 MHz $250.00

TS-148—Spectrum analyzer, X band, $129.50

TS-186—Freq. meter 100-10,000 MHz $149.50

UPM-8—Signal generator, 980-1230 MHz. Also used as pulse generator $39.50

TS-13—X band signal generator $49.50

I-222—Signal generator, 8-15 MHz & 45-77 MHz $39.50

TS-14 Signal generator 3200-3370 MHz $39.50

Binary Radiation Counter for research $29.50

TS-35—X band signal generator $34.50

TS-345—Noise and gate generator $24.50

TS-250—Altimeter test set $12.50

TS-155—Signal generator 2700-3400 MHz for testing receivers and transmitters and for supplying trigger pulses $97.50

TS-230—Power meter. Designed to measure frequency of unmodulated and pulsed signals in the range of 85-9700 MHz.
New, with fittings $49.50

TS-573/UP—Radar range calibrator, portable used calibrating pulse radar systems used for tracking or automatic signal. Range strobe output. Variable from 100 yds. to 200 miles $97.50

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TCS—12 volt dynamotors assym. 4 transmitter & receiver. Completely filtered, can also be used to operate SCR-522, ARC-3, 4, 5 etc. New, each $9.95

Converter-Rotary type—12-24 volts to operate 24 volt equipment without any internal changes in the equipment. Will deliver 24 volts at 4 amps. Each $9.95

PE-125—12 volts, 15 amps input. Output 425 volts DC at 200 ma. Has starting relay, fuses and completely filtered, Each, ... $9.95

24-Volt generator at 25 amps, new $8.95

Laminated core for 275 watts power supply. Stack 2 for 375 watts. (QST Dec. 1964 for details), Each $1.95

Power Supply for BC-603 or BC-683, 110 VAC, Each $9.95

RA-43 Power Supply. Input 110 volts 60 cycle Output 110 volts 525 watts, in excellent condition. Weighs 165 lbs, Each $14.95

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MANUALS

ARC-27 transceiver	$7.50
ARC-1 transceiver	4.95
BC-604 & 603	2.50
BC-611 Walky-talky	1.50
SCR-625 Mine Detector	1.25
GRC RT-66, 67, 68	2.95
PRC-6	1.95
Special Model 15	7.50
BC-191 Trans.	1.95
BC-342 Rec.	1.95

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200 KHz metal holder	$1.95
200 KHz 241 holder	1.25
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500 KHz 241 holder	.97
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COMMAND EQUIPMENT

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3-4 MHz transmitters, Each $9.95

ARC-5/VHF transmitters, 100-150 MHz, new condition, with tubes, Each $14.95

3-6 MHz receivers, excint cond, Each $12.95

6-9 MHz receivers, good cond. Each $9.95

BC-459 ARC-5 modulators, Each $5.95

BC-442 Antenna relay, new $2.25

MISCELLANEOUS

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RM-52 Phone Patch Special: Comes complete with UTC83719 transformer $1.95

RM-53 Phone Patch Special: A more elaborate unit with sensitive 4 ma plate relay. This unit can be used for phone patch as is, without any changes $2.95

Technical manual for above $0.49

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AN/TRC-24: T-302A, AN-912,3 R-417A, AM-914,5, PP-685A & accessories.

AN/TCC-3: AM-682, TA-219

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INDICATORS: ID-250,1, ID-387, ID-257, ID-663, ID-1103, ID-637, etc.; all Collins, Weston, and A.R.C. indicators and control units.

TEST EQUIPMENT
SG-12A/U
AN/URM-25
AN/URM-26
SG-1A/ARN
SG-2A/GRM
AN/URM-80
SG-13/ARN
AN/URM-81
AN/ARM-8
AN/URM-32
AN/ARM-25
AN/ARM-68
AN/URM-48
AN/ARM-22
AN/ARM-66
AN/USM-26
AN/ARM-65
SG-66A/ARM-5
AN/URM-43
AN/UPM-98
AN/ARM-68
MD-83A/ARM
AN/UPM-99
AN/USM-16
TS-723/U
OS-8E/U
TS-757
TS-330
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TV-2C
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TS-710
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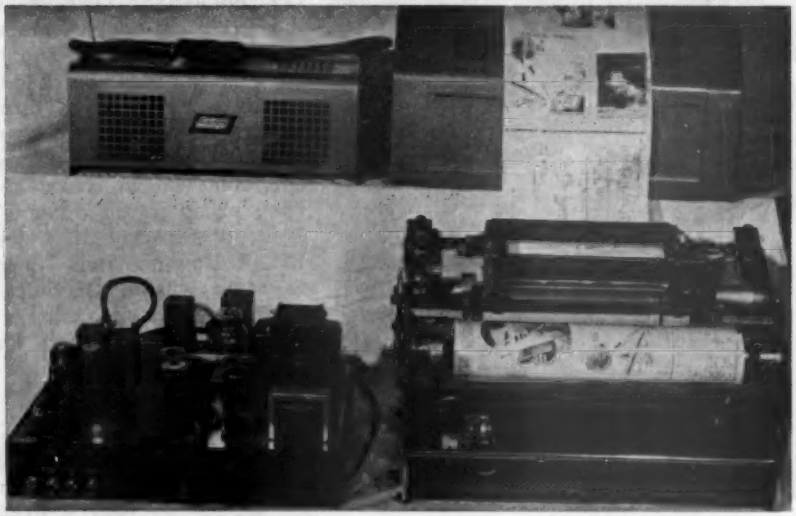

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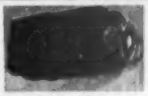

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satellites are 8 x 8.5 inches. For additional information on receiving pictures from the Automatic Picture Taking satellites, see: QST, Nov. 65, p. 11. CQ, Sept. 66, p. 44. Electronics World, March 67, p. 23. CQ, Aug. 66, p. 25. Electronics, July 27, 1964 p. 81 & 99. These machines will send and receive pictures, schematics, etc., up to 8.5 x 14". They can be used on the 2 meter band and up without any additional equipment other than your AM or FM receiver and xmtr. When transmitting, it provides a monitor copy which is an exact reproduction of the picture being transmitted. 100Ft rolls of recording paper are readily available at a cost of less than 2 cents per picture!

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Face-Lifting the TS 34/AP Oscilloscope

The TS 34/AP Oscilloscope is one of the best buys on the surplus market today but, due to its World War II vintage, it is sometimes by-passed for other equipment. When you look at a TS 34/AP it reminds you of the old kaleidiscopes found in penny arcades at amusement parks—the kind you squint into to see the girlie pictures. The TS 34/AP is something on that order but a face lifting will make it look like a million dollars.

This oscilloscope is a real fine instrument and has many excellent operating characteristics. It's light weight and small size make it an excellent portable or fixed station scope. The TS 34/AP operates from 110 volts at 50 to 1200 Hz and draws 90 watts. The sensitivity is .1 to 100 volts and sine waves are observable from 30 Hz to 1 MHz.

The first job is to bring the 2AP1 tube up forward. This simple modification makes better viewing of the cathode-ray tube from all angles so you don't have to squint into the scope to view the test pattern. Remove the top cover of the cabinet and take out the long black Armco-iron shield over the CRT. Save the small shield which is inside the long one. Next measure 7⅛ inches in from the socket end (rear) and cut off the shield with a hack saw. This short shield will be used when the tube is moved to the front.

Next we work on the front end of the top cover to prepare it for insertion of the 2AP1 tube. The eye-shade or hood should be removed, leaving an oval hole. This hole must be enlarged to take a round meter bezel, 2 to 2¼ inches in diameter. I used a meter bezel which I found in the junk box. Prepare a new sub-panel 7 x 3¼ inches which is to be fitted over the enlarged hole. Do-it-yourself aluminum was used here. Cut out the hole in the center of this panel for the bezel; fasten panel and bezel to the top cover.

The top cover needs more surgery, so cut out a hole 10 x 5 inches right in the center. Start 2¾ inches from the front edge. This hole will be used later for adjusting the installation of the 2AP1 tube. You will also need it to replace tubes. Next make a cover or lid to fit over this hole using do-it-yourself perforated aluminum and fasten it with self-tapping screws. Allow at least a one inch margin around this lid so it will be secure when fastened to the cover. When this is finished, paint the new and old parts of the top cover with a spray-can.

Our next job is to move the 2AP1 tube forward by lengthening the wires going to the tube socket. The present socket will be moved forward about seven inches. Allow enough wire when splicing the additional wire to the original leads. To get an idea of the length of the required splices, place the 2AP1 temporarily in the bezel and measure the additional wire length to each pin of the socket. It is a good idea to lace and bind these wires together when splicing is completed. A bracket must be made to hold the shield, similar to the original bracket at the rear of the chassis. It can be made from a small piece of aluminum shaped like the letter Z. It is then fastened to the screw just in front of the 6AG7. This screw and washer hold down the phenolic tie point board. The bracket should have a nut and screw attached to it so that the little fork on the rear of the shield fits down on it and holds secure.

Now the final adjustment of the face lifting. Fasten the socket into the Armco-iron shield. Take the small shield and insert it inside the larger one. The 2AP1 tube is then pushed down through the shield until it fits into the socket. Then the tube and shields are placed through the bezel. The small fork on the outer shield is fastened to the screw and nut on the bracket. To keep the tube rigid, put a piece of rubber around the edge of the 2AP1 tube.

If you have followed these simple instructions you will have a scope of modern design and you can enjoy the capabilities of this $1,000 instrument—that's what the government paid for it.

. . . K6GKX

Howard S. Pyle W7OE
3434 74th Avenue, S.E.
Mercer Island, Washington 98040

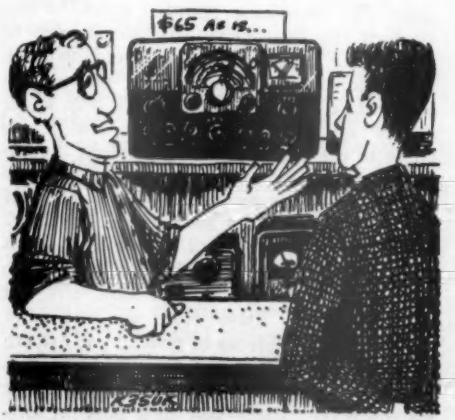
Climbing the Novice Ladder

Part VII: Judy and Joe take their written exams and report on their transmitter hunt.

By the following Saturday neither FN nor Larry had received the sheets for the written portion of the novice exam for Judy and Joe from FCC but the two youngsters had not wasted any time during the week. In addition to cramming for the exam they had made the rounds of the local ham stores and accumulated some ideas for their transmitters. FN had accordingly invited them to drop out and discuss what they had found, so early that afternoon they peddled out to his shack.

Judy opened the discussion; "Gramps, we saw quite a bit of some pretty nice gear down-town but those we think we'd like to have were way out of our price class. Joe starts working at the supermarket on Saturdays right after school opens and with what he'll make there and what he has saved from his paper route, he figures he can go about $60 for a rig. Me, I'm not quite so flush; I don't have any job prospects except occasional baby-sitting and I don't have *too* much left in my piggy bank . . . about $20 is all." Joe then chimed in with "Well, I'm luckier than Judy as I already had a receiver and didn't have to buy one; what I saved there can go on the transmitter. I saw a couple of jobs I'd like to have but they're a bit complicated for me. Jim Turner has a Viking Ranger for $65.00 but it's priced that low because the modulation section is burned out. Larry took a look at it with me and said, from the looks of it quite a bit of work would be necessary and I'd have to buy a new modulation transformer and maybe both tubes. I'd like to have phone after I get my General ticket but Larry advised against tackling the repairs on the Ranger; what you think?"

"I think Larry is right, Joe. If the modulation section is gone it's very possible that you'll find more trouble in the rf portion. Generally, when the major portion of a transmitter goes out, it carries other things along with it and you may bite off quite a frustrating job if you go for that one.



Joe considers a Ranger in need of repair. "Dad . . .

A Ranger is a swell little job when it's operating normally but if it has been abused, it isn't exactly child's play to restore it; I believe I'd forget it if I were you. What was the other one you saw Joe?" "Well, it was a military surplus job . . . a TCS with an AC power supply and it had been modified and fixed up so it would handle 20, 40 and 80 OK . . . no 15 though. Jim was asking $45 for it which Larry says is a good price but he wasn't too keen about it. The modifications weren't too well done and the power supply was a home-brew job and kinda sloppy although Jim said the set-up worked very well; he tried it out before he took it in on a trade. I might be getting a bag of lemons though if I bought it off the shelf".

"Neither the Ranger nor the TCS sound like very good bets to me Joe," FN replied, "I think you can do better than that. What about a new kit job? You've had enough electronic building in school so that you shouldn't run into any great amount of trouble putting one together and then you'd have something modern and new so you shouldn't experience any grief there. Did you look over the kit catalogs?" "Yes, FN, I did" Joe returned, but I just kinda thumbed through 'em . . . didn't really come up with anything; I thought I'd see what you thought about the Ranger or the TCS first". "All right, Joe; suppose you take a *good* look at what Heath, Knight, Eico and others have to offer. Read the dope thoroughly on each one and drop back in a few days and we'll talk about it. Now Judy, $20 isn't going to get you much of a transmitter although if you want to, you can get a time payment deal on something pretty good." "No, Gramps, my little income is too unstable to sign up for something maybe I couldn't pay for. I don't think Dad would want me to either; he'd have to guarantee it you know at my age" she laughed. "Joe and I are going to the club with Larry tonight though and they're going to have an auction; maybe something will turn up there for both of us . . . let's wait and see Joe, OK?". "Sure" said Joe, "another day or two won't hurt us and I'd rather get something I want than take a chance". "Good idea kids" FN put in, "sometimes these club auctions offer some pretty fair pieces of gear . . . it's worth a try". "OK Gramps, we'll take in the auction and I'll let you know tomorrow how we made out. Larry said he'd pass on anything that looked good before we went for it" and with those parting words, Judy mounted her bike and led off with Joe following on his Honda.

The following day Judy's family made the trek out to FN's place where they were joining the older folks for Sunday dinner. Judy immediately cornered FN and said somewhat dubiously but with obvious excitement, "Do you know Gramps, there was only *one* transmitter offered at the auction and it was a six and two meter transceiver; nice looking job but it was nothing for Joe and me to start our novice career with; it went for $85 to the highest bidder which was out of our class anyway. "But" and Judy glowed but still looked a bit dubious, "one of the hams at the club told me that he just got the latest "Blue Book" listing of re-conditioned equipment from World Radio Labs and as there was nothing that he wanted this time, he gave it to me as it had several nice little transmitters on it. I brought it along Gramps; there's one that sounds pretty good to me but it's $35. Dad said though that if you approved it, he would give me the other $15 I'd need, for a birthday present . . . I'll be 17 Wednesday you know!" "Let's have a look Judy; maybe you've hit a jack-pot; WRL generally have a pretty good assortment and you can't go wrong dealing with them . . they're good people. Ah, theres' seven transmitters on here; four of those you could use . . . the others' are kinda in the money; which one were you thinking of?". I kinda like that little Viking Adventurer; Larry had one once and said it's a dandy little rig and an FB novice transmitter; has all of the bands and is crystal controlled . . runs about 50 watts. Larry gave me a catalog sheet on it and I read it over . . here it is . . what do you think of it?" "Judy, maybe you *have* hit a jackpot here. As I remember, those little jobs cost about $65 or $70 as an unassembled kit and WRL is offering it completely wired, reconditioned and tested for $35. Not bad . . . not bad at all. Let me read this description sheet to refresh my memory; I knew these little rigs once but some of the details escape me now. Uh, huh, crystal control for your novice start and when you get to be a General you can build or buy a VFO to plug into it; fine. Also, if you want to take a crack at radiophone, a simple little modulator is not hard to build for a rig of this power. The circuit is conventional, the keying is clean and it has band switching . . . no

plug-in coils to monkey with. Here's something too that I bet you overlooked on WRL's list; your Dad won't have to put up as much dough as he thinks . . you get a 10% discount if you don't offer a trade-in to partly pay for it; costs you only $31.50 that way!" "Gee Gramps, I *did* miss that . . it sounds better yet . . what do you say?" FN took a couple of deep drags on his pipe, removed it from his mouth and said, "OK Judy; I'll give you a green light on that one; don't see how you can go wrong. I'd move fast though for someone may snap it up if you delay. If WRL pronounces it OK, thats' good enough for me and they're not very far from here . . just over in Iowa . . so your parcel post cost won't be very great. Let's talk to your Dad now".

Bubbling over with excitement, Judy shouted to her Father, "Wait up Dad; we've got something to talk to you about". Tom Mansfield, who was examining a new colt in the corral, turned and smiled as he saw Judy's eager approach. "I know." he said, "and I'll bet it'll cost me money". "Remember Dad, you said you'd pay off what I needed if FN said I should get that transmitter. Well he did and it's not going to cost you so much either; we get 10% off as long as we don't have anything to trade in on it". Laughingly Tom turned to FN and

we've got something to talk to you about . . ."

The neat little re-conditioned transmitter which Judy chose for her initial station.

said, "I knew you'd scheme between the two of you to take me to the cleaners but I'm a man o' my word you know. You think it's OK for her to buy this little transmitter then, eh FN?" "Yes, Tom", his Dad replied, "it's a good little rig made by a well-known and reliable manufacturer and offered by an equally reliable mail order firm. It's really a good buy and I'd say go for it. "OK" replied Tom, "we'll make out an order tonight Judy and I'll mail it in town first thing in the morning." With stars in her eyes Judy exclaimed, "Well, that takes care of me; I beat Joe to it anyway . . . wonder what he'll come up with".

The morning mail brought Judy's FCC examination papers to FN and he phoned to let her know that he had received them. Naturally anxious to get her license as soon as possible Judy asked, "Gramps, would it be OK if I peddled over this afternoon and you gave me the exam?". FN chuckled, realizing her eagerness but replied, "I'm sorry Judy but I've got a man coming out to figure an irrigation deal for me this afternoon. I'll be free in the morning though and you'll be fresher; why don't you come out then?" "OK Gramps, I'll be there at 9 o'clock . . OK?". FN assured her that it was and then asked, "Do you know if Larry got Joe's papers this morning too?" "Oh yes" replied Judy, "I nearly forgot; Joe phoned and said Larry called him and said he had his papers now but he is going to examine Joe right at home this evening; Larry works weekdays you know until college starts". "Fine" said FN, "we'll each examine our own candidates separately then; you be out here in the morning and I'll put you through the hurdles." "OK Gramps, bye-bye and '73' "

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and Judy hung up.

When she arrived next morning, FN told her that Joe had called and said that Larry had examined him the previous evening. Joe hadn't found it too difficult and Larry told him that while he could not give him an official opinion it appeared to him that Joe had made the required percentage nicely and probably with some to spare; the real decision would come from FCC of course. Joe had also discussed kits with FN and seemed to have more or less settled on one and would be out the next day to talk with him about it.

FN, complying with the instructions on the examination paper envelope, opened it and passed the contents to Judy, asking her first to read the envelope instructions which were directed to the applicant and to follow them to the letter. After doing so, Judy carefully read over the questions, pondering a few of them with furrowed brow and then carefully marked off what she considered the correct answer on the formal answer sheet supplied. She had completed all of the answers in little more than half an hour while FN read the morning paper and smoked his faithful briar. Being a thorough-going youngster, Judy carefully went over all of her answers, pausing at two points to do a bit of deep thinking and then carefully and *completely* erasing two answers and substituting new marks. "There Gramps," she finally announced, "that's it; I think I've got most of them correct, at least according to the way I understand it; what now?" "That's all of it girl; the rest is up to me and the FCC. I have to sign the statement on the back, stick the whole business in the envelope you brought with you and drop it into the post-office when I go down for the mail this evening. From then on it's waiting game for you. You'll either get a notice of failure from FCC or a brand-spankin' new license and a set of call letters. Don't be in a dither though until you get word; may be in two weeks, maybe three, possibly six or eight. The FCC is efficient but remember they have lots of other divisions besides amateur and they are far from overstaffed. It is anybody's guess when you'll get the word. *Don't* try to rush 'em by sending an inquiry; you'll more than likely delay rather than help, whatever action they take. Just be patient; FCC has just recently mechanized their license processing which should speed up the

issues but you'll not be a licensed operator until you get that all-important little card in the mail. Meanwhile, you're waiting for your transmitter to arrive too so why don't you just go play with your dolls or make mud pies or whatever you girls do to pass time!" "Oh Gramps, "dolls . . . mud-pies . . . what you think . . . I'm still five years old?" she laughed. "Don't worry, between Dad and Mom they'll dream up enough chores around home to keep me occupied. What do *you* think I did with the exam though?". "Well Judy," FN replied, "I'll give it the once-over but just as Larry told Joe, there can be nothing official about what I say . . . all I can do is express a *personal* opinion; the FCC will give you the answer straight across the board; just a minute now". FN then carefully ran his eyes down the question sheet mentally checking each answer as he went. In a few minutes he said, "I'm going to say that I'm pretty sure you'll make it. There were a couple of places where I think you could have done a bit better but to me it appears that you have more than an adequate number of correct answers to make the grade. We'll just seal it up now so I can mail it this evening and wash our hands of the whole biz till the magic word arrives". Judy was already atingle with hopeful anticipation as she mounted her bike and peddled swiftly homeward.

The next morning Joe appeared at FN's place ready to discuss his thoughts on a transmitter. He lost no time in announcing, "FN, I think I've found it. The more I studied

". . . What do you think about it, FN?"

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the catalogs the more I kept coming back to the little Knight-Kit T-60. Lots of kits were pretty keen deals but the Knight-Kit seemed to hit me just about right. Larry says I can't go wrong on that . . . what you think about it?" "Well son, Larry is right; the T-60 is a neat little package and not too difficult to put together and get on the air. You know of course that it also has modulation in it which involves a bit more work than just a straight CW kit assembly but not at all beyond you. You'll probably want to work a bit of phone after you get your General license so you're that much ahead. About all you'll need to add when you get the higher grade ticket is a VFO and you can pick one up at a modest cost or you can build one if you're so inclined. I'll go along with you on the T-60 and I'm sure you'll find it a dandy little rig. I'm sure you won't have any trouble putting it together and wiring it but if you need any help, drag it out here and we'll both get on it". "Thanks FN," replied Joe, "but you've already done a lot for us kids and Larry has offered to give me a hand if I need it so I think I'll tackle it on my own and bring it out for you to look over and test when I'm through with it. The little thing is just within my budget so I'm going to order it from Allied tonight as long as you've OK'd it. It only has to come from Chicago so I should have it in a week or less". "OK lad, go ahead and buy it; I've seen and tested quite a few of those little rigs and if you do a reasonably good job in putting it together and follow the book right to the dot, you'll have yourself a nice piece of gear. Like I told Judy, I'd like both you kids to let me know two things; tell me when you get your transmitters and let me know when you hear from FCC. You probably will both be ready to go on the air by the time your license is in your hands. Larry told you I suppose, that it takes more than a few days to hear from FCC?" "Yeah, FN; waiting will be a bit rough but nothing we can do about it; we'll let you know when word from FCC and our transmitters shows up". So saying. Joe hopped his Honda and took off, stopping at Judy's on his way home to compare examination reactions. As their session lasted all afternoon, obviously it was not *entirely* concerned with electronics!

W7OE

Next installment: Judy and Joe reach the top of the novice ladder!

Ham Public Service and Broadcast Stations

Ross Sheldon
3313 Avery S.W.
Huntsville, Alabama 35805

In any major town there is certain to be a broadcast station specializing in spot news. Such stations have both phone patch and phone recording equipment. They welcome phoned-in tips and recorded news stories.

Here in Huntsville, Alabama, as a part of the Huntsville Amateur Radio Clubs program of public relations and public service, spot broadcasts giving hurricane news picked up by ham radio are broadcast regularly during the hurricane season. If other clubs decide to do this, here are some tips:

Care should be taken to confine broadcasts to specific hurricane information, omitting names and reports of damage, injuries and other such "scare" items. Such items are usually exaggerated and often completely false. Leave that type information to the news gathering agencies.

Following is the script of one of the broadcasts made here, which others may use as a guide:

(BACKGROUND MORSE CODE ON RECEIVER LOUD THEN FADE)

"This is Ross Sheldon, an amateur radio operator, relaying to radio station WAAY the latest hurricane Alma information as received by amateur radio from amateurs in the Carribean area.

"The amateurs from Puerto Rico to the Canal Zone and along our gulf coast report that Hurricane Alma is now 230 miles SSW of Ft. Myers, moving at 16 miles per hour in a northerly direction. It should pass abreast of Ft. Myers, moving at 16 miles per hour in given as to when or where it will strike the central gulf coast.

"Winds at the center are 110 mph with gale force winds spreading out 250 miles in all directions.

"Shortwave listeners wishing to hear up-to-the-minute information on the hurricane should tune to the amateur radio hurricane net now in operation on 14,325 kHz where tape recorded weather bureau reports and other hurricane information is being relayed to isolated areas by amateur stations engaged in hurricane duty.

"This is amateur radio station K4HKD returning you to WAAY."

(BACKGROUND CODE UP AND OUT)

Note the favorable publicity given amateur radio by these broadcasts which are a public service to the people in the threatened area and to relatives and property owners outside the area.

To get information, tune to, but do NOT transmit on, the hurricane net frequencies. Relay stations will repeat weather bulletins several times, so you do NOT have to ask for fills. PLEASE DO NOT TRANSMIT!! Note the stated time of the weather bulletin. If it is an hour old and the hurricane is traveling 20 mph, the center is obviously 20 miles farther along. Correct for this in your report. WARNING! Do NOT forecast the eventual route the hurricane will take. Hurricanes change direction quickly and unpredictably, hence even the weather bureau will not predict the complete path. Damage suits from those claiming the wrong forecast lulled them into a false sense of security are possible. Just stick to the facts and DON'T SPECULATE OR TRY TO INTERPRET.

Lay your groundwork in advance by finding out which stations will accept information by amateur radio. (Showing them this article might be a good idea.) Ask whether they just want the information, or wish to tape broadcasts by phone. If they have a teletype which gives them the same information you hear the hams passing on the air they will be interested primarily in the "color" of the spot broadcast from a ham, plus whatever additional information you may pick up.

Type up a complete broadcast, leaving blanks to fill in with the changing data in pencil. (distance and direction from what city, wind velocity, direction and speed of travel, etc.). Read it aloud at least twice at newscast speed to see how it sounds and times before calling the station to record the tape. The shorter the tape, the better. I aim for 50 seconds with a minimum of 30 and a maximum of 90 seconds.

It's a public service—and darn good public relations. If you can swing it.

. . . K4HKD

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Gus Browning W4BPD
Cordova, South Carolina

Gus: Part 24

At the end of the last chapter I had just entered the Union of South Africa from Bechuaniland, one of the most desolate spots I have ever seen—or at least the portion I saw. At least the good roads I found in South Africa made the rattley old bus a lot easier to ride on and I could again open my mouth without fear of my upper plate falling out, and *this was good!*

We stopped at the little Customs House at the border and in we all went, me and those genuine Africans (I was the only European on the bus, and I did look sort of "out of place"). I guess I had even soaked up some of the usual "aroma" that the Africans have. I noticed that the Customs Officials did not get too close to me for some reason; I guess that "aroma" caused it. I guess he had me tagged as some crazy American, poor as a church mouse, riding that African bus (he had me tagged right too). He must have figured that it was not possible for someone like me to have anything of real value since the questions he asked went somehing like this: where were you born, what nationality and color were my mother and father, (maybe I had gotten a little suntan by this time making me look somewhat off-color to him), did I have any fire arms, any ammunition, any transistor radios, or political affiliations and with whom? He made a few tick marks on the customs forms and said sign here—this I did gladly. As there was no inspection of anything on the bus, the Africans and I piled back on and away we went for what they call Jo-burg (Johannesburg to you fellows).

I was met by ZS6IF, Lamberth; everything was loaded in his car, and away we went for his QTH. I headed to the shower to change my color and smell; I really needed that shower and when I emerged from it I felt like a changed man. Boy, it was wonderful! We went to Lamberth's shack to the rear of his garage. Lamberth is a Dutchman who QSYed to ZS land some years ago; I think he said about 1955 or so. By the time I arrived he had changed 100% from being a Dutchman to a South African.

His was just about the cleanest, smoothest, slickest ham shack I have ever seen. Everything was home built and I mean beautifully built. Everything looked as if it was just finished, cleaned up and polished yesterday—it might have been too. Lamberth was one of those typically thorough Dutchmen in his job and you could see it was finished by a master craftsman right down to each screw being tightened up so the screw slots were even lined up; each solder connection was one of the wiped jobs, the kind most hams don't have the time or inclination for anymore. His keyer, key lever, etc. were all home constructed. It made me glad to know that there are fellows in the ham world who still go to all the pain and strain to do such masterful work as Lamberth had done there.

We sat in his ham shack and had one of those fine business eye-ball QSO's—the kind any of you fellows would like to have with some of the DX stations in distant parts of the world. He wanted to know about any number of W/K DXers he had heard and been working all these years and all about their rigs. He wanted to know the type of bottles, plate voltage, and current they used; also, all about the kinds of antennas the top boys were using in the States. Luckily, I think I personally knew every fellow he asked me about and I even knew something about many of their rigs. I could never be sure of the exact plate voltage or current they ran; most of them did use a kilowatt more or less when I visited them, but at that time nothing rare was coming through—you might say the going was not on the rough side at that moment

MESHNA SURPLUS BARGAINS

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4096 core $12.50 * 8192 core $15.00

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—so just one kilowatt. You can't be too sure of what might happen to the voltage and currents later on!

Lamberth and I sat there and yakked away, drinking some wonderful Dutch coffee his wife brought in to us every now and then. Lamberth still had some of that Dutch accent and his wife's accent was very strong. His children spoke perfect English and I think all of them spoke the native language they call Afrikans, which is a combination (I think) of Dutch, English, Flemish and maybe even a few other European tongues mixed with some native South African dialects. They say it's a very difficult language to learn. I don't know because I don't think I ever learned more than two or three words of this complicated, tongue-twisting way to speak.

The next morning we went out in his back yard and looked over his beam—I think it was a quad. He showed me the moon bounce dish he was constructing—it was a real beauty, absolutely perfectly built. I hear now that Lamberth's interest is moon-bounce or tracking satellites and other UHF activity; since I have not been hearing him on the bands, I suppose this may be true.

Lamberth and his wife were very FB hosts to me. Lambreth drove me around Jo-burg quite a bit, showing me the various sights there. One of the oddest things to be seen are those huge mountains of earth in and around Jo-burg. We stopped beside one of them and I got out of the car to look at it closely. It seemed as if it was almost as hard as cement—not a blade of grass was seen growing on these hills. I asked Lamberth why this was and he told me the chemical process they used to extract the gold made it impossible for anything to grow.

I talked to a ZS station a few years after my visit there and he told me that some chemist had found that it was now possible for grass to be grown on this rock by some kind of treatment to the soil. I think he also said that a special grass seed was used to seed the tops of some of these mounds. He told me that someone had built a drive-in theatre on top of one of them, so I I guess they won't be absolutely useless from now on.

Lamberth drove me out to spend the night with Brian, ZS6ANE (America North East as he calls it). He lived all they way across town from Lamberth. Brian is a young married chap with one little girl who was about 3 years old. He is a very likeable fellow with a wonderful wife. We went to his hamshack and sat up quite late having a good eyeball QSO; there were even Cokes in the Fridge, which made the stay with them that much better. The next few days were spent visiting a number of ZS6 fellows and seeing their ham shacks. All were very well equipped and had good antennas; they all seemed to be good operators.

Oh yes, Lamberth asked me if I had declared my gear to Customs when I had entered the country; I told him I had not. That's when he said that it was going to be very difficult trying to get it out of the country when I was ready to depart. I told him I had never had any trouble getting things out—getting them in yes, but not getting them out. He said, "Well, you have never tried getting things out of South Africa yet." I did find a solution to this problem later on but that's another story and will be dealt with in full at the point where it enters the story. It worked out quite well in the end.

I really got to see some of the country around Johannesburg, spending about 5 or 6 days there, sort of biding my time for the departure date of the ship to Tristan, Gough and Bouvet Island. I found I had a few more days to spend between Jo-burg and Capetown so I got in touch with Sid, ZS4MG, in Kroonstaid (about one-third the distance from Jo-burg to Capetown). I gave him a DX phone call and made arrangements for him to meet me when I arrived there via the train from Jo-burg.

The train arrived in Kroonstaid about 1 AM and there was Sid at the railway station in his little car—with his little goatee and all. When he arrived at his home his very sweet wife was still up—she even had a big supper on the table for me. I could see immediately that my stay with them was going to be one of the stops where I could pull off my shoes, roll up my pants, and dive into the Fridge when I wanted to.

They told me to make myself at home while there and that's exactly what I did, every minute of my stay. I was even allowed to operate from his station—up to then I had not done very much operating from ZS land. I had a number of FB rag chews with Gus Watchers, as some of them called themselves. I told them how things were progressing towards my forthcoming trip to the islands. I always believe in keeping the

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fellows back home well informed so they can be on the air when you arrive at a rare country.

I knew all about some of the fellows taking days off from their work to contact me. I knew many of them would want to know which day they should play sick. I had even heard of one of them flying back to his home in Ohio from his Texas vacation spot just to work a new one. There is, I am told, a doctor in NYC who will leave his patient on the examination table when one of the fellows gave him the land-line buzz that I was on the air. Bill Eitel of Eimac told me that so many of his crew got sick on the first day I landed at some spot and got going, that their production was very drastically cut! Of course, I think he was pulling my leg.

I can't see any real reason why, under normal conditions, a fellow can't tell you where and when he will be at such and such a spot, provided he knows when it will be. You go on a DXpedition to work as many fellows as possible and this is one way to make sure you get plenty of callers when you get going from a "gud one". Sometimes I know it's not a good policy to announce too far in advance where you are planning on going; there is the possibility of some eager beaver beating you there or maybe getting telegrams or air mail letters to London to stop you. Under these circumstances it's always best to play it cool and keep your mouth shut. I learned this the hard way on the Chagos trip. This might explain why Don Miller stays real quiet most of the time as to where he is going or planning on going.

Sid had a very nice peach orchard right in his back yard, the peaches were about one to two months from being fully ripe, and that's when I told him and his wife I most certainly would stop by and see them on my return from the islands. I told them about my being from the part of the USA where peaches and watermelons grew the best and how I loved to wrap my lips around peaches and whipped cream (um umm). He said he would hold a few treefuls just for me to eat upon my return.

I sure hated to leave Kroonstaid with all that fine home cooking and the real friendship that both of them extended to me, but I kept looking at the calendar and saw "D" day for the ships departure from Capetown creeping up on me.

Late one evening I boarded the train for Capetown; Sid and his wife and daughter saw me off, and away I was for Capetown. A really smooth ride all the way down. Those South African trains are very plush and smooth riding and the food in the dining cars is very good and reasonably priced. The cost of the fare was reasonable too. Arriving in the vicinity of Capetown at sunrise the next morning I could see that it was quite hilly around the country and city.

Marge and Jack—ZS1RM and ZS1OU—met me at the railway station. They had the mayor of the city along with them, and after a very fine welcome, they insisted we stop at a cold drink bar for a Coke (it took practically no convincing, I must say). As usual when we sat down and ordered the drinks, (we all ordered Cokes) I told the waitress to be sure to bring mine in the bottle, please. She said OK, and as is usual, she brought it to me in a glass.

I refused the drink and told her I wanted it in the bottle; with a half frown she then brought me another, this time in the bottle. The mayor said, "There is no difference," and that's when I said, "Oh, yes there is, I am a connisseur of Cokes, I know when they are best." He and Jack and Marge had theirs in a glass, then they all ordered another Coke in the bottle. Right there in the drink bar they had a sip and smack test of Cokes—they would sip a little from their glass, then take a swig from the bottle; after a little of this testing all three decided that there *is* a difference. They all said it was much better directly from the bottle!

If I did nothing else in South Africa, I converted three people to drinking Cokes the right way—directly from the bottle! After this little episode the mayor departed, I guess for his office, and Jack, Marge and I departed for The Strand where they lived in an upstairs apartment overlooking the beach. The Strand of Capetown is a beachside resort area, a sort of holiday spot, where everyone goes on the week ends to swim, fish, golf, etc. Marge works in a beauty parlor and Jack sells insurance. They are not in the wealthy class at all; they are regular down to earth kind of people and their's is not a fancy apartment. They had held a bedroom especially reserved for me, and their Fridge was jammed full of Cokes, fresh figs, Cape grapes, cantelopes, watermelons, and other goodies.

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They took me into the radio shack (which is not unusual you know) and I was shown how to turn on the rig, turn the beam, and they said, "Gus, the rig's yours as long as you are here with us. Make yourself right at home and sleep as late as you wish." After a good many hours of eye-balling they departed for bed, leaving me in the shack. I immediately went on the air, getting on 14065, my DXpedition frequency; called a CW CQ and had quite a ball working the boys in the States, telling them that Tristan da Cunha and Gough and Bouvet were getting closer and closer all the time.

I stayed up until about 3 AM having myself quite a ball I must say. I dragged myself away from the pile-up that was still calling me and slept until 10 AM the next morning. When I got up, Marge and Jack had left a note on the rig, so I would be sure to see it I suppose, telling me to go right ahead and fix my own breakfast; they had to go to work. This was really making me feel right at home—they had turned the whole house over to me and they again said I could use the rig as much as I wanted to.

I had a very leisurely breakfast of coffee, cantelopes, even ate a big slice of watermelon—for breakfast. Man, this was like being back in South Carolina eating watermelon for breakfast. I did miss my grits and sausage and eggs and Peggy's cooking though.

. . . W4BPD

VK7TR

VK7TR, Ray Conrad of Hobart, Tasmania, was completely burned out in the great fire which recently swept the South Australian Island. His home and all contents including all his radio gear, QSL's and logs were completely destroyed. Ray and his XYL escaped in their car from the fire which descended on their home at 75 mph. If those to whom VK7TR owes QSL's will send new cards to his old QTH or to VK7CK, he will attempt to QSL from memory. Ray and his XYL are leaving April 22 for an extended trip stateside via England. He expects to hit New England and Pennsylvania after August 20, then on west across the USA and back home. Don't be surprised to hear his melodious accent from G3LSF, W1BCR and W3CES and others.

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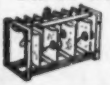

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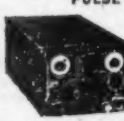

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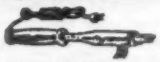

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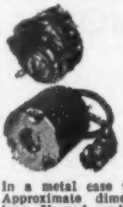

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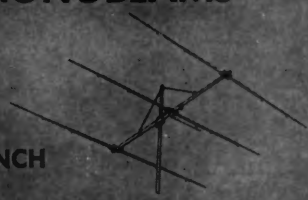

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Letters

(cont'd from page 4)

Dear 73,

Your March issue of 73 Magazine with the 73 transistor circuits is by far the best issue I've ever received . . . I work the Air Force MARS CW Transcon Net and used the audio passband filter described in Fig. 14 between the headsets and the receiver. It sure does the trick at 7332 kHz which is close to the CHU time signals. It completely eliminated CHU and brings CW signals up no end—hence I am figuring on setting the thing between the first audio and second detector of my receiver. This way I won't have to wear a set of "cans" all the time.

With this filter in my receiver I am able to give all the fellows a QSA5 QRK5 signal report, but when I take it out there is so much crud on the darned frequency that it knocks 'em down to 2/2 for sure.

Charlie Holstrom WA 0 GYK
Fairbury, Nebraska

Dear 73:

I am particularly interested in transistors and while all 73's are good, this one is the goodest—uh huh. So send 3 copies of March please. I have some kids I'm getting started in transistors too.

Walt Burdine W8ZCV
Waynesville, Ohio

Unhappy

Dear 73:

I have just one fault to find; the magazine gets here very late . . . very fine on everything else. I think you are putting out a fine magazine and I will support it all I can.

Glen Wilson WA6ORZ
San Pablo, California

This issue was mailed on May 20th. The July issue will be mailed on the 10th of June. After that all magazines will be mailed by the 10th of the preceding month.

Kudos

Dear 73:

I just had to sit down and write you a letter. What about? Many things, —first of all, about the quality of 73's articles. Superb! In the past eleven years of hamming I know of no mag that equals yours.

Scanning a typical issue of 73, the transistor articles immediately catch my attention—I usually spend at least an hour on these gems—next a quick trip to the back, the best place to begin reading any mag, plus I always find something interesting in New Products and Books.

Whenever Jim Fisk describes some phase of hamming through his high quality booklets—he receives my vote every time! More of the same Jim! The technicians up here found the Coaxial Handbook invaluable, but myself—being a solid state nut—devoured "73 Useful Transistor Circuits".

Roy Schoonover 3C8AG/VE8
Winnipeg, Manitoba, Canada

Dear 73:

More than 50 years ago I purchased my first ham radio equipment. The receiver was slider tuned with an electrolytic detector using a Wallaston spring wire contacting an acid solution in a carbon cup. The transmitter used a spark gap.

Today I'm still enthused as I read your selected articles on new equipment and how to build one's own.

Phil Shigley WB6SJA
Redding, California

Dear 73:

For the past several years now, I have enjoyed receiving my copy of "73 Magazine". I look forward to seeing many new and different approaches to construction articles and feel that this magazine keeps me more than adequately supplied.

Incidentally, I also write a weekly column for one of the local newspapers and find this very rewarding with respect to the interest generated in 'the hobby'.

Hoping to build up the Transistorized Digital Identification Generator and have already written to Barry Todd regarding the diode matrix. Last summer I got "hooked" on the integrated circuit keyer, and can only say that it works like a champ.

RTTY is my chief interest these days, would sure like to see more articles in this vein. Possibly I can add my two cents worth at some future date.

James H. Sayer, VP9BY
Smiths Parish, Bermuda

Dear 73:

I saw a March 1967 issue of 73 magazine last night at our ham meeting and it sure did impress me. All those real interesting transistor circuits. I don't see how you can put so much good information in one publication.

I have been taking the ARRL QST, but my subscription is up and I am going to take 73.

You may be interested to know that one of our ham friends who is well educated in electronics made the statement last night at the ham meeting, "I have been taking QST magazine, and I am so far behind I was unable to read 73." That is how much he has been missing my not subscribing to your magazine earlier.

Please start my subscription with the March 1967 issue—I sure do want that book.

Levy Belcher K4T8X
Glasgow, Kentucky

Dear 73:

Congratulations on the February 73 which arrived here today. I have been a subscriber of 73 from issue number one and have written publicly about it in our Break-In—you have now hit the jackpot with the new binding. Of the material inside, there is always much of interest for me so I continue to rate the magazine number one . . .

Jock White ZL2GX
Contest and Awards Manager
New Zealand Association of
Radio Transmitters

Dear 73:

I've been wanting to tell you how much I, a non-ham, enjoy much of 73. I'm not qualified to comment on the technical articles (my husband says at least once a month, "73 sure has it beat over the other two"), but I certainly find the overall magazine much more appealing than CQ or QST. I've taken a "beginning beginner's" course in electronics and absorbed quite a bit by osmosis (what wife could avoid that when her husband is afflicted with the disease of ham radio!) and occasionally I even find a technical or general information article I can muddle through.

I don't want to ramble on, so I'll just say that in this household 73 is considered tops.

Mrs. Heather Jorgensen
XYL of K1DCK

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Meters, Digital

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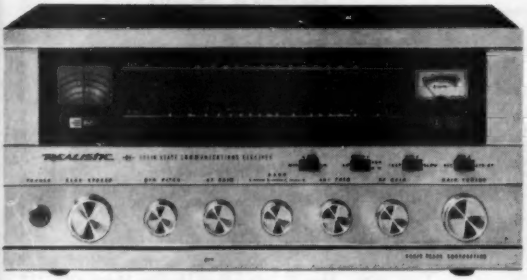

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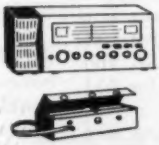

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Heathkit SB-301

The new Heathkit SB-301 Amateur Band Communications Receiver is an improved version of an already famous pacesetter, the SB-300. Some of the new features of the SB-301 are increased sensitivity, full RTTY provisions, 15 to 15.5 MHz coverage for WWV, built-in automatic noise limiter, and front panel switching of the optional six and two meter converters.

The SB-301 covers 80 through 10 meters with provisions for AM, CW, upper and lower sideband and RTTY. It has a crystal-controlled front-end which provides the same tuning rate on all bands. The pre-assembled and calibrated Linear Master Oscillator (LMO) features linear tuning and excellent stability. The sensitivity of this new receiver is better than 0.3 microvolts for 10 dB signal-plus-noise to noise on all bands. The built-in crystal filter exhibits selectivity of 2.1 kHz at the 6 dB points for SSB and RTTY. Optional filters are available for AM (3.75 kHz) and CW (400 Hz).

The SB-301 is fully capable of transceive operation when operated as a companion to the SB-401 transmitter. When the optional six and two meter converters are plugged in, the SB-301 provides full amateur band coverage from 80 through 2 meters complete with front-panel switching. Look for a complete review of this versatile new receiver in this issue. For complete specifications and the schematic diagram, write to the Heath Company, Benton Harbor, Michigan 49022.

Heathkit SB-401

The new Heathkit SB-401 80 through 10 meter SSB Transmitter is an improved version of the widely chosen SB-400. The engineering department at Heath has added many new features to this rig to make it even more versatile that its predicesser. The new SB-401 offers a front-panel control to switch from independent to transceiver operation when used with the Heathkit SB-301 (or SB-300) communications receiver. This control and the allied circuitry that go with it also enable the SB-401 to be operated as an independent transmitter with any communications receiver—all you need is the Heath SBA-401-1 crystal group.

One of the amazing things about this new transmitter is its cost—it is forty dollars less than the preceding model! Even with the optional crystal group installed the new SB-401 is ten dollars less. The specs of the new SB-401 are just about the same. It still runs 180 watts PEP on SSB on 170 watts CW. Linear tuning is provided by the Linear Master Oscillator and the 1 kHz dial calibration permits frequency repeatability within 200 Hz. It features a built-in antenna change-over relay, a relative power meter, VOX *and* PTT control, and LSB, USB or CW.

In addition, Heath has changed their assembly plan to "sub-pack" packaging. Now basic portions of the transmitter are assembled as individual units. The builder opens only the packages of components necessary for that part of the SB-401 he is about to assemble. Unit by unit he progresses toward completion. In this way, the number of components involved at any sequence is cut down and there is less chance for error. Besides, it's easier.

For more information on this new transmitter, and a complete set specifications and the schematic, write to Heath Company, Benton Harbor, Michigan 49022.

(Turn to page 132)

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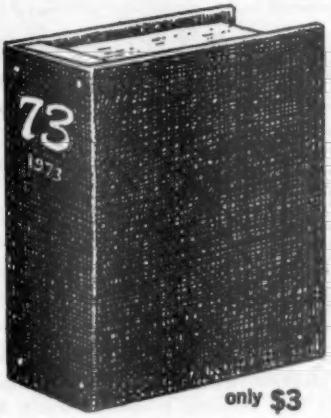

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New Products

(from page 130)

Poly Quad Antenna Kits

The Polygon Plastic Company has entered the amateur radio field with a unique fiberglass cubical quad antenna kit. Already a nationally known manufacturer of industrial fiberglass products and the "Glas-Lite" fiberglass sporting goods line, Polygon has adapted a three piece tube with strength equal to, or even greater than, the best 13 foot continuous length pole.

The entire kit is mailable, thus reducing shipping cost and time. Most important is the sky-blue epoxy paint used on the standard kit spreader. This paint protects the fiberglass from weather and ultra violet ray deterioration adding years to spreader life. It also tends to make the mounted antenna less conspicuous and therefore, less objectionable to neighbors. The most advanced and economical feature of the kit is the spreader mount—called the Starmount. Using only a wrench and screwdriver, the amateur can adjust the Starmount to fit booms from 2 to 3 inches in diameter. He can go from dual to multi-element arrays without buying all new hardware. The Starmount is diecast of proven corrosion-resistant, high strength aluminum alloy. The boom-to-mast adapter is also fabricated from a high quality aluminum alloy.

A comprehensive and illustrated 28 page manual offers simple instructions enabling the average Ham to construct the Poly-Quad in a matter of hours. Selection of boom, wire and reflector tuning methods is left to the individual customer. Kits are available with 2, 3 and 4 elements in tri and duo-band series. Components are also sold separately. For more information, write to Polygon Plastic Company, 7 Industrial Park, Walkerton, Indiana 46574.

Amperex Linear IC's

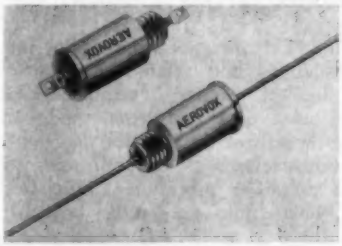
Amperex has announced the availability of five new linear monolithic IC's. The most advanced type in the line is the TAA320, an optimum performance audio frequency semiconductor device. Trade-named the 'BiFET', it is the world's first bipolar/mosfet integrated circuit amplifier. This new design concept enables the unit to take 100 volt transients, features a G_m of 40,000 μmhos and has an input resistance of 10,000 megohms.

The new model TA310 is designed specifically as a record/playback preamplifier. It provides 100 dB gain with less than 4 dB noise. The TAA293 features complete accessibility to all internal connections to provide wide application flexibility. It is ideally suited for audio and *if* applications, or as an amplifier, oscillator and multivibrator in other low-frequency functions.

The new Amperex TAA103 is the smallest linear integrated circuit amplifier presently available. The plastic flat-pack in which it is packaged measures a scant 0.002 cubic inches. This IC features 75 dB gain and is ideally suited for amplifier applications from dc to 600 kHz.

For more information on this new line of integrated circuits, write to Amperex Electronic Corporation, Semiconductor Division, Slatersville, Rhode Island 02876.

Aerovox RF Suppression Filters



Although these filters were designed for the military market, they should find use in amateur equipment where severe rf suppression requirements exist. These miniature ceramic filters come in twelve different models for rf suppression from 150 kHz to 10 GHz (10,000 MHz). For more information write to Aerovox Corporation, Olean, New York.

WRL 1967 CB Catalog

Although this new catalog from World Radio Labs was put together specifically for the citizens band operator, there are many items included which are of interest to the amateur. Test equipment, antenna accessories, feedline, rotors, tools and components are included as well as a full line of CB gear. For your free copy write to World Radio Laboratories, 3415 West Broadway, Council Bluffs, Iowa 51501.

(Turn to page 134)

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New Products

(from page 132)

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The Components Division of the JFD Electronics Company has just announced a universal top tuning assembly which adapts all JFD piston capacitors for top tuning and vertical mounting. These units are ideal for applications in equipment where space is at a premium and top tuning is required.

These components are available in two wire and pin or four wire configurations for printed circuit use. The unit shown here has a range from 2 to 25 pF, a working voltage of 500 Vdc, and Q of 600 at 20 MHz. For further information, write to JFD Electronics Company, Components Division, 15th Avenue at 62nd Street, Brooklyn, New York 11219.

Amperex Semiconductor Catalog

Amperex has just announced the latest edition of their condensed Semiconductor Catalog. This new catalog contains the basic specifications and related material on the full line of Amperex semiconductors. It serves as a quick reference guide and includes specification lists and associated applications references on transistors, diodes, audio amplifier assemblies, integrated circuits, heats sinks and audio kits. In addition, there is a list of Amperex Application Reports. Free copies may be obtained by writing on your company letterhead to Amperex Electronic Corporation, Advertising Department, Hicksville, Long Island, New York 11802.

1967 EICO Catalog

EICO has just announced publication of their new 1967 catalog. This new catalog features EICO's complete line of 200 electronic kits and factory assembled instruments for hams, electronic technicians, hobbyists, CB'ers and audio buffs. Among the new EICO items included in this catalog are their 717 Electronic Keyer, 711 Shortwave Receiver, 888 Engine Analyzer and "Cortina" solid-state stereo. Also included are the EICOCRAFT Solid State electronic kits—seventeen different units for many applications. For your copy of this new catalog, write to Electronic Instrument Company, Inc., 131-01 39th Avenue, Flushing, New York 11352.

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Ground Equipment: PRC-8A, PRC-9A, PRC-10A, PRC-25, AN/GRC-3 thru 85, RT-66 thru RT-70/GRC, UPX, UPA, APR-14.

Receivers: R-220, R-274C, R-388, R-389, R-390, R-391, R-392/URR, SP-600JX, RBL, SP-600VLF, R-836/ARN, BC-348, AR-88D, 75S-3, 75A4, 51J-4, 51S-1.

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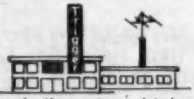

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DRAKE AC4	79	SX111	149	SP600JX	399
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SBE34	349	HT46	259	HEATH HR10	67
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INTERCEPTOR	257	NC109	79	HX10	199
ALLBANDER	69	NC125	89	HW12	79
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NEW SWAN 500, 117XC speaker, supply unopened factory cartons, warranty, $478. HQ-170, clock, manual, mint condition, $115. W4HKQ, Don Payne, Box 525, Springfield, Tenn. 37172.

TRANSFORMERS: Filament-transistor power supply: 6.3 VAC at 1.5 A, 115 VAC, $1.00 each pp anywhere in U.S. No minimum order. Electro Systems, 3496 Zisch Dr., San Jose, Calif. 95118.

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HEATH SB-300 with filters, $250; SB-400, $295; SB-301-3, $19; Table top KW linear, $125; others write. Shideler, 2812 Tenth, Arcadia, Calif.

VIKING-1 6146's PA TVI'd VFO PTT filter RCA AR88LF 60KC-30MC all $150. Buyer inspects/collects. K2BJB, 25 Tudor Ave. Pine Beach, N.J. 08741.

VIKING VALIANT, $170. HRO-50 with crystal calibrator and 5 coils, $125. Central Electronics 10-B, $45. Albert Thomson, W8DTI, 2645 Forest Grove S.W., Wyoming, Michigan 49509.

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BACK ISSUES: 73-CQ-QST-Radio. Write, for list. W. Conant, 15424 Chase St., Sepulveda, Calif. 91343.

DUMMY LOAD 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 KW, kit $7.95, wired $11.95, pp Ham Kits, Box 175, Cranford, N.J.

CLIFF DWELLER 75/10 meter rotatable dipole. First owner, not rusty, $50; HT32A immaculate condition, $250. Want transceiver. Marty WB6-NWW, 5349 Abbeyfield, Long Beach, Calif. 90815.

SWAN 250 AC SUPPLY, Mark VI Linear, many extras, Johnson 6N2, National VFO, Tapetone WTC-1300; best offer. Richard Solomon, 25 Regina Rd. Dorchester, Mass.

FOR SALE: Swan 350 w/AC power supply, $375.00; SB-200, 1200 W PEP linear, $175.00; HA-650 6-meter portable xceiver, $100.00. All equipment mint, perfect working order. Ken Feldman WB6FRP, 705 Gayley Ave., Los Angeles, Calif. 90024.

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Considered a life time battery, they may be re-charged indefinitely and may be left charged or discharged with no ill effects. Rate of discharge is many times the rated AH and is almost flat at rated AH. Four sizes presently available all in excellent gaurenteed chargeable condition. All are 1.2 volts.

80 AH $7.50 50 AH $5.95
32 AH $3.95 4 AH $1.75

Panoramic Indicator

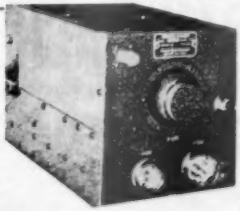
IP-274/ALA-

This panoramic adapter was written up in the June 1964 issue of "73" Magazine. It is a 14 tube scope using one or more of each of the following tubes: 3BP1A 6BE6, 6BA6, 6AL5, 6J6. 6SL7, 6SN7, 6AC7, 884, 0D3, 1B3, and 6X5.

A. R. C. TYPE 12

RECEIVERS

R 10 - 520 to 1500 KC $19.50
R 11 - 190 to 550 KC 24.50
R 13 - 108 to 135 MC 29.50
R 19 - 118 to 148 MC 35.00



These receivers are continuously tunable over the ranges indicated and are furnished with tubes in either new or very good condition.

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Direct indicating frequency meter covering 25 to 5000 cycles in four ranges --- .1 KC, .5 KC, 1 KC, & 5 KC. Exc. cond. $37.50

OIL-FILLED CAPACITORS

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.06 "	15000 "		9.95
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2 "	20000 "		49.95

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TCS EQUIPMENT

NAVY TCS RECEIVER AM

1.5 MC to 12 MC in two (2) bands. Variable freq. oscillator & crystal control on four (4) preset channels in the entire freq. range. Audio output 1.5 watts into 500 ohm load; uses tubes 12SK7 RF A., 12SA7 converter, 2/12SK7 IF A., 12SQ7 detector BFO, 12A6 oscillator, 12A6 audio Amp. 456 KC IF Freq. Large vernier & spin dial, audio gain, AVC, BFO and all controls on the front panel. Voltages required: 12 VDC & approx. 220 VDC 100 MA. Size: 11¾ x 11¾ x 13¾". Wt.: 37 lbs. .....USED: $44.95

NAVY TCS TRANSMITTER AM—

1.5 MC to 12 MC in three (3) bands, CW 40 watts, voice modulation 20 watts, master oscillator variable and crystal control on 4 preset channels in the entire freq. range. Uses 3/12A6 in oscillator & buffer-doubler, 4/1625 in modulator & power amplifier stages, 2½" meters for PA Plate 0-300 DC RF meter 0-3, all tuning and operating controls on front panel. Voltages required: 12 VDC & 400-440 VDC 200 MA. W/tubes. Sizes: 11¾ x 11¾ x 13¾". Wt.: 41 lbs. .....USED: $34.50

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D-401 Transmitter Dynamotor 12 V. .....New: 6.95
D-402 Receiver Dynamotor 12 V. .....New: 4.95
CABLE—Receiver to Power Supply .....New: 2.75
CABLE—Transmitter to Power Supply .....New: 2.75
Connector Plugs for Remote Control Box .....New: 1.50
A C POWER SUPPLY—115 V. 60 cycle (Not Government Surplus). Receiver: $50.00—Transmitter: $35.00.
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Propagation Chart

JUNE 1967

ISSUED APRIL 15

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7A	14	14	14	14
ARGENTINA	14A	14A	14A	14	14	14	14	14	21	21	21A	21
AUSTRALIA	14	14	14	14	7B	7	7A	7A	7	7	14	14
CANAL ZONE	21	21	14	14	14	14	14	14	14	21	21	21
ENGLAND	14	14	7A	7A	7A	14	14	14	14A	14A	14A	14A
HAWAII	14A	21	14	14	7	7	7A	14	14	14	14	14
INDIA	14	14	14	7B	7B	7B	14	14	14	14	14	14
JAPAN	14	14	14	14	7	7B	14	14	14	14	14	14
MEXICO	14A	14A	14	14	7	7	14	14	14	14	14A	14A
PHILIPPINES	14	14	14	7A	7B	7B	7A	7A	14	14	14	14
PUERTO RICO	14	14	14	7A	7	7	14	14	14	14	14	14A
SOUTH AFRICA	7B	7B	7B	14	14	14	14A	14A	21	21	14	14
U. S. S. R.	14	14	14	14	7	14	14	14	14	14	14	14
WEST COAST	14A	21	14	14	7	7	7A	14	14	14	14A	14A

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7A	7	7	7A	14	14	14	14
ARGENTINA	14A	14A	14A	14	14	7	14	14	21	21	21A	21
AUSTRALIA	21	21	7A	14	14	14	7A	7A	7	7	14	14
CANAL ZONE	21	21	14	14	14	14	14	14	14	21	21	21
ENGLAND	14	14	7A	7A	7	7	14	14	14	14	14	14
HAWAII	21	21	14	14	14	14	7A	14	14	14	14A	14A
INDIA	14	14	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	7A	7	7	7A	14	14	14	14
MEXICO	14	14	14	14	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7A	7B	7B	7A	14	14	14	14
PUERTO RICO	21	14A	14	14	7	14	14	14	14	14A	14A	14A
SOUTH AFRICA	7B	7B	7B	14	7B	14	14	14	14	14A	14	14
U. S. S. R.	14	14	14	14	7	7	14	14	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7A	7	7	7	7A	14	14	14
ARGENTINA	21	21	21	14	14	7	14	14	21	21	21A	21A
AUSTRALIA	21	21A	21A	21	14	14	14	14	7A	7	14	21
CANAL ZONE	21A	21A	21	14	14	14	14	14	14	21	21A	21A
ENGLAND	14	14	14	14	7	7	7	7A	14	14	14	14
HAWAII	21	21A	21A	21	14	14	14	14	14	21	21	21
INDIA	14	14	14	14	14	7B	7B	7B	14	14	14	14
JAPAN	14	14	14A	14	14	14	7A	7A	14	14	14	14
MEXICO	14A	14A	14	14	14	7A	7A	14	14	14	14A	14A
PHILIPPINES	14	14	14	14	14	14	7	7	14	14	14	14
PUERTO RICO	21	21	14A	14	7	7	14	14	14	14A	21	21
SOUTH AFRICA	7B	7B	7B	14	7B	7B	14	14	14	14	14	14
U. S. S. R.	14	14	14	14	14	7	7	14	14	14	14	14
EAST COAST	14A	21	14	14	7	7	7A	14	14	14	14A	14A

A. Next higher frequency may be useful this hour.

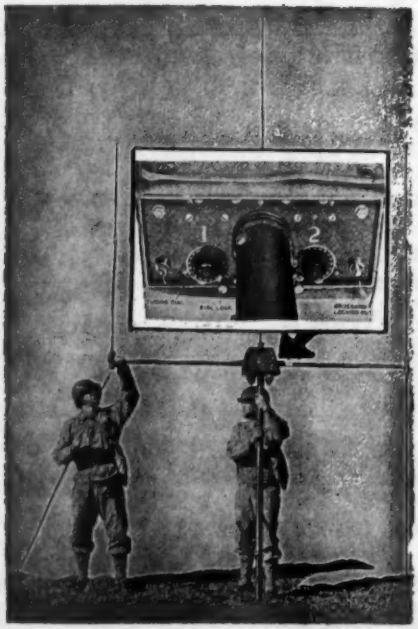
B. Very difficult circuit this hour.

Good: 1-8, 10-13, 15-17, 19-21, 23-30

Fair: 9, 14, 18, 22

VHF: 5-7, 10-13, 15, 20, 24-27

TELEMARINE CLEARANCE BARGAINS!



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BC-611 WALKY-TALKY

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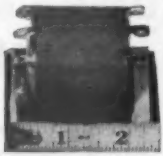

Build your own transistorized mobile power supply for less than $15.00, and cut down battery drain 60% or more. Power transformer employs powdered iron core (approx. 1000 cps), with feedback winding, and at 300 ma load still delivers 410 volts. Dim: 2½" L x 2¼" H x 2¼" D. We furnish diagram and construction details. New units, shipg wt. 1½ lbs, **EACH**..... **$6.95**

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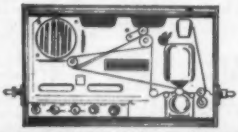

Learn to copy code or improve your speed with this unit. For individuals, schools, etc. Complete, portable automatic unit for reproducing audibly (built-in loud speaker) code signals recorded in ink on paper tape. Pre-recorded tapes, lessons 1-15 (on 15 reels) available from many other surplus houses. Also usable for practicing "sending" by means internal oscillator, keyed by external hand key. Operates from 90 to 130 V or from 190 to 240 V 60 cy AC. Units are used. Very good condition. Ship wt. 54 lbs. **SPECIAL** **$15.95**

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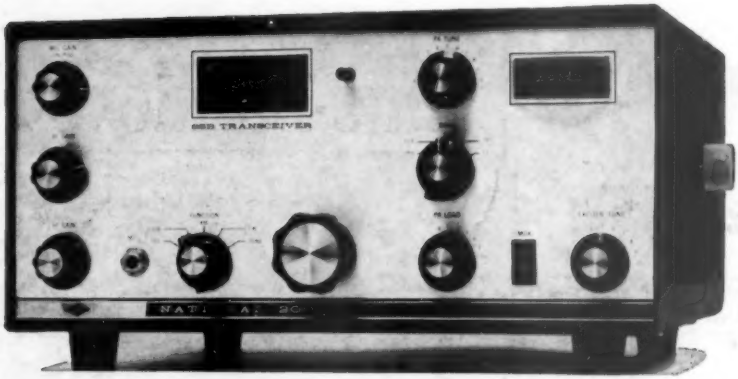

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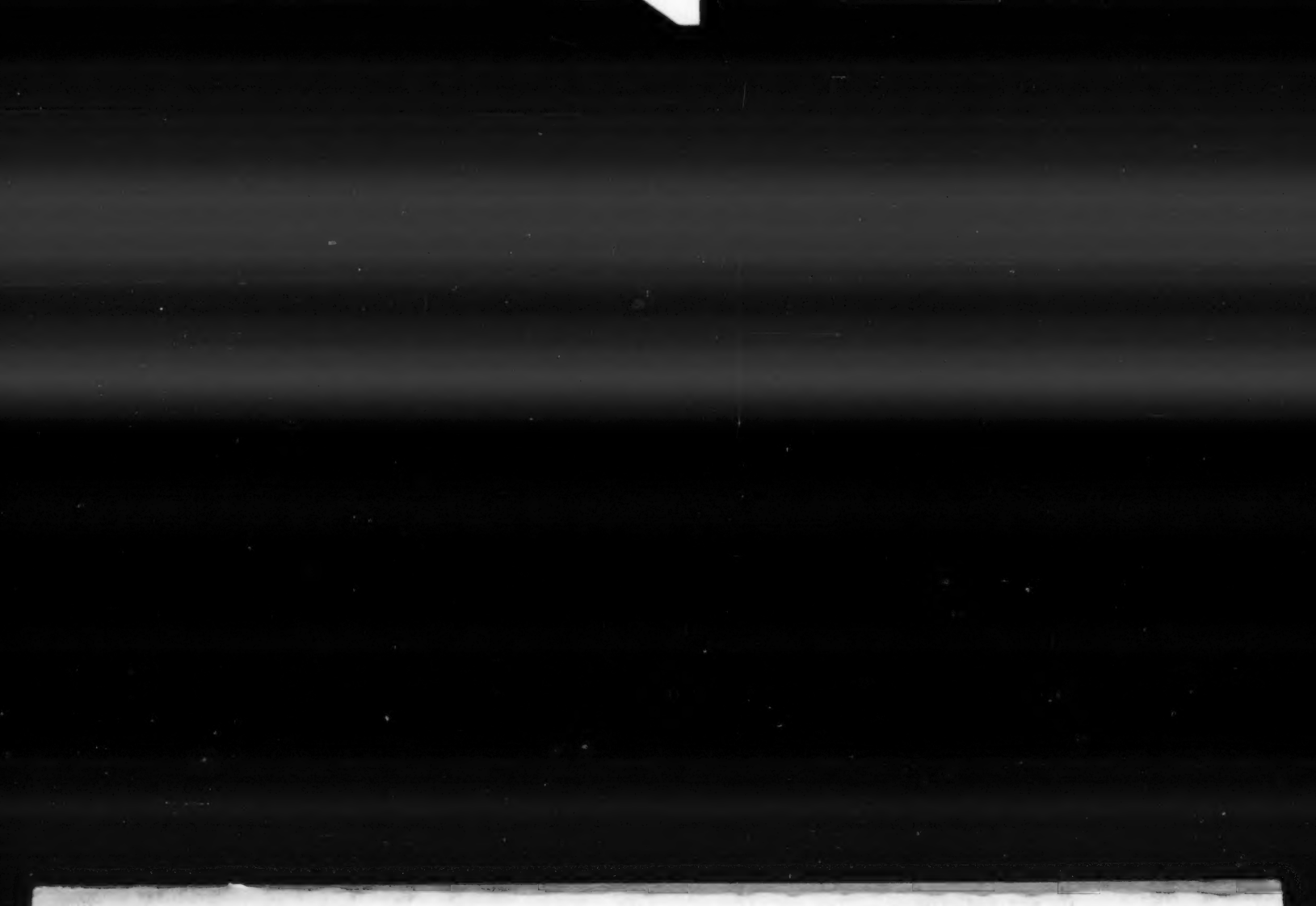
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